Smithsonian Contributions to Knowledge.

THE ANCIENT FAUNA OF NEBRASKA:

OR,

A DESCRIPTION OF REMAINS OF EXTINCT MAMMALIA AND CHELONIA,

FROM THE MAUVAISES TERRES OF NEBRASKA.

BY

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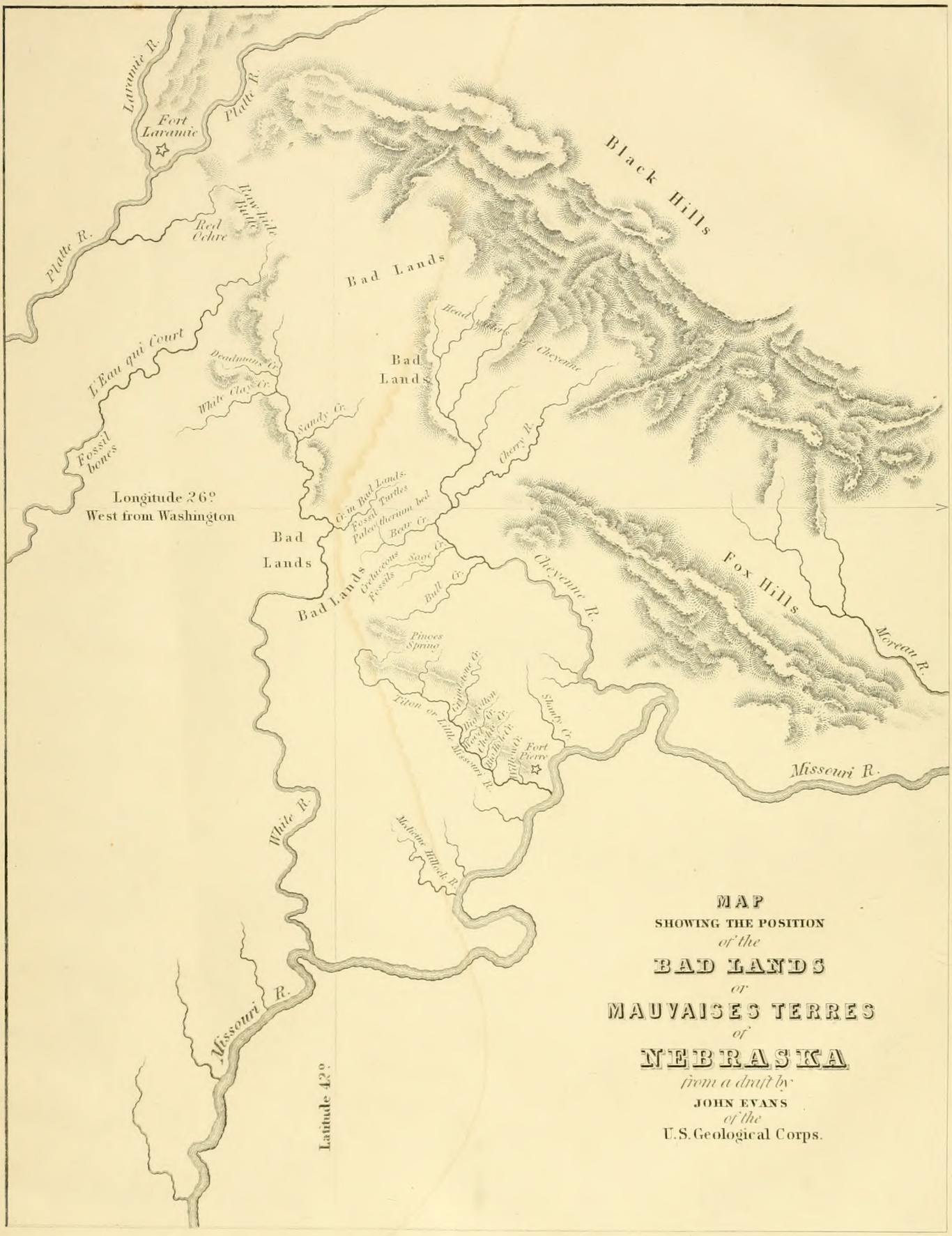
with the author's respects.



MAP
SHOWING THE POSITION
of the
BAD LANDS
or
MAUVAISES TERRES
of
NEBRASKA
from a draft by
JOHN EVANS
of the
U.S. Geological Corps.

SMITHSONIAN CONTRIBUTIONS TO KNOWLEDGE.

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PREFACE.

THE present Memoir, entitled "The Ancient Fauna of Nebraska," is founded upon a large and highly important collection of fossil remains of Mammalia and Chelonia, of the Eocene Period, from Nebraska Territory, which have been submitted to me for examination by the Smithsonian Institution, Dr. David Dale Owen, of New Harmony, Indiana, and Dr. Hiram A. Prout and Prof. O'Loghland, of St. Louis, to whom I express my sincere thanks for the interest they have taken in my labors.

To Prof. S. F. Baird, Dr. S. D. Culbertson, Messrs. Alexander, Joseph, and Thaddeus Culbertson, Capt. Stewart Van Vliet, Dr. S. G. Morton, Dr. John H. B. M'Clellan, Dr. A. H. Senseny, and Mr. J. S. Phillips, I am also obliged for the aid which they have contributed to the work.

I embrace the present occasion to acknowledge the talent of the artists who have added so greatly to the value of the Memoir, by the excellent and faithful drawings which accompany it, viz.: Mr. A. Sonrel, of Woburn Centre, near Boston, and Messrs. A. J. Ibbotson, A. Frey, F. Shell, and I. Butler, of Philadelphia.

INTRODUCTION.

It has ceased to be a startling fact that, prior to the advent of man, a long series of ages had rolled by, during which numerous races of plants and animals successively originated and became extinct; and we no longer doubt our power to unveil the past, even to the period when the encrinite, the trilobite, and the brachiopod, were the sole representatives of life upon our planet.

In the earliest known palæozoic rocks, remains of invertebrate animals only have been found, and fossil fishes are first discovered in the upper Silurian formations. Recently, remains of reptiles have been detected in the Old Red Sandstone of Morayshire, Scotland,[1] but it was not until the middle of the Secondary Period that this class of animals appears to have reached the acme of its development.

The era of the origin of birds will probably always be involved in more obscurity than that of the other vertebrata, as, from their physical construction, their remains are the least likely to be preserved. With the exception of footprints, supposed to be those of birds, but which may yet prove to be of reptiles, in the sandstone and conglomerate of the valley of the Connecticut, no truly characteristic remains of the former class have been discovered in any of the primary or secondary fossiliferous strata.

Of mammalia, a few undoubted remains have been found even as low in the geological series as the Trias. Prof. Plieninger recently discovered, in the bone-breccia of Würtemberg, two molar teeth, supposed to have belonged to an insectivorous animal, to which the name *Microlestes antiquus* has been given.[2] In the same deposit, Prof. Plieninger found several incisor teeth, which he considers to have appertained to a species of fish allied to *Sargus*, and, therefore, proposes for the animal the name of *Sargodon*, but Jaeger suspects they also may have belonged to a mammal, which was allied to the *Anoplotherium*, Cuvier.[3]

In the Stonesfield slate of Oxfordshire, England, belonging to the Oolitic Period, seven halves, singularly enough, of lower jaws, have been discovered, which have been referred to three species of two genera of insectivorous marsupialia: the *Amphigonus Prevostii*, Ag.; *Amphigonus Broderipii*; and the *Phascolotherium Bucklandii*, Owen.[4]

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[1] *Telerpeton elginense*, Mantell: Quart. Journ. Geolog. Soc., 1852, VIII. 100.

[2] Würtemb. naturw. Jahresb., 1847, III. H. 2, 164.

[3] Fos. Säugeth. Würtemb., 1850, 139.

[4] Jahrb. von Leon.u.Bronn, 1835, 186; Owen: Trans. Geol. Soc., 1841, VI. 47, 58; Brit. Fos. Mam., 29, 61.

In Europe, no remains of mammals have been detected in the cretaceous series, but in this country several vertebræ have been found in the Green Sand of New Jersey, associated with bones of the *Mososaurus*, which I have referred to two species of cetacea, under the names of *Priscodelphinus grandævus* and *Priscodelphinus Harlani*.[1]

The tertiary geological period is remarkable for the great number of mammals which have been ushered into existence in successive races, and in the same course have become extinct.

In Europe, the earliest tertiary or eocene formations have yielded an extraordinary abundance of mammalian fossils, in which we have reason to feel a peculiar interest, as, through the brilliant genius of Cuvier, they became the opening chapter to the great volume of palæontological science.

Until recently, in North America, the only mammalian genus which had been detected as a member of the early Tertiary Period was the huge cetacean, the *Basilosaurus*, Harlan, from the eocene deposits of Louisiana, Alabama, and South Carolina. Of this genus several distinct species have been indicated as follow:—

Basilosaurus cetoides, Gibbes: Journ. Ac. Nat. Sc., 1847, I. 5.
Zeuglodon cetoides, Owen: Trans. Geol. Soc., 1841, VI. 69.
Zeuglodon macrospondylus, Müller: Fos. Res. d. Zeug., 1849.
Basilosaurus serratus, Gibbes: Journ. Ac. Nat. Sc., 1847, I. 5.
Zeuglodon brachyspondylus, Müller: Fos. Res. d. Zeug., 1849.
Basilosaurus pygmæus?
Zeuglodon pygmæus? Müller: Fos. Res. d. Zeug., 1849.

Quite lately, I referred a cervical vertebra found at Ouachita, Louisiana, to a new genus of cetacean animals under the name:

Pontogeneus priscus? Leidy: Proc. Ac. Nat. Sc., 1852, VI. 52. (This may belong to the *Basilosaurus pygmæus*.)

Very numerous remains of extinct mammalia have also been discovered in the miocene and pliocene deposits of Europe, and likewise in those of the latter period in the Sivalik Hills of the Himalayas of India, in South America, and Australia.

The mammalia, which have been indicated as belonging to the Miocene Period of North America, are as follow:—

Phoca Wymani, Leidy. Wyman: Am. Journ. Sc., 1850, X. 229.
Phocodon, Agassiz. Wyman: Ibid., 56.
Delphinus Calvertensis, Harlan: Proc. Nat. Inst. Washington, 1842, II. 195.
Delphinus Conradi, Leidy: Proc. Ac. Nat. Sc., 1852, VI. 35; Wyman: Am. Journ. Sc., 1850, X. 231.
Balæna palæatlantica, Leidy: Proc. Ac. Nat. Sc., 1851, V. 308.
Balæna prisca, Leidy: Ibid.

In the pliocene deposits of this country the remains of extinct mammalia are very numerous, and a large number of species have been determined as follow:—

Cervus americanus, Harlan: Fauna Amer., 1825, 245.

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[1] Proc. Ac. Nat. Sc., 1851, V. 327.

CERVUS ———?

Elaphus americanus, De Kay: Nat. Hist. New York, 1842, Pt. I., Zool. Mam., 120.[1]

BISON LATIFRONS, Leidy: Proc. Ac. Nat. Sc., 1852, VI. 117; Smiths. Contrib. to Knowl., 1852, V. 8.

Bos latifrons, Harlan: Fauna Amer., 1825, 273.

BISON ANTIQUUS, Leidy: Proc. Ac. Nat. Sc., 1852, VI. 117; Smiths. Contrib. to Knowl., 1852, V. 11.

BOOTHERIUM CAVIFRONS, Leidy: Proc. Ac. Nat. Sc., 1852, VI. 71; Smiths. Contrib. to Knowl., 1852, V. 12.

Bos Pallasii (in part), Dekay: An. Lyc. Nat. Hist. of N. York, 1828, II. 280.

BOOTHERIUM BOMBIFRONS, Leidy: Proc. Ac. Nat. Sc., 1852, VI. 71; Smiths. Contrib. to Knowl., 1852, V. 17.

Bos bombifrons, Harlan: Faun. Amer. 1825, 271.

OVIS MAMMILARIS? Hildreth: Am. Journ. Sc., 1837, XXXI. 82.

HARLANUS AMERICANUS, Owen: Proc. Ac. Nat. Sc., 1846, III. 94; Journ. Ac. Nat. Sc., 1847, I. 18.

Sus americana, Harlan: Amer. Journ. Sc., 1842, XLIII. 143.

PLATYGONUS COMPRESSUS, Le Conte: Am. Journ. Sc., 1848, V. 103; Trans. Am. Ac. Arts, 1848, III. 257; Leidy: Trans. Am. Phil. Soc., 1852, X. 323.

DICOTYLES DEPRESSIFRONS, Le Conte: Proc. Ac. Nat. Sc., 1852, VI. 3; Leidy: Trans. Am. Phil. Soc., 1852, X. 323.

DICOTYLES TORQUATUS (*fossilis*).

Dicotyles costatus, Le Conte: Proc. Ac. Nat. Sc., 1852, VI. 5.

PROTOCHŒRUS PRISMATICUS, Le Conte: Am. Journ. Sc., 1848, V. 105; Leidy: Trans. Am. Phil. Soc., 1852, X. 323.

EUCHŒRUS MACROPS, Leidy: Trans. Am. Phil. Soc., 1852, X. 323.

EQUUS AMERICANUS, Leidy: Proc. Ac. Nat. Sc., 1847, III. 262.

HIPPARION VENUSTUM, Leidy: Proc. Ac. Nat. Sc., 1853, VI. 241.

TAPIRUS AMERICANUS (*fossilis*). Carpenter: Am. Journ. Sc., 1842, XLII. 390; Ibid., 1846, I. 247; Leidy: Proc. Ac. Nat. Sc., 1849, IV. 180.

Tapirus mastodontoides, Harlan: Fauna Amer., 1825, 224.

TAPIRUS HAYSII, Leidy: Proc. Ac. Nat. Sc., 1852, VI. 148.

ELEPHAS AMERICANUS. (*The fossil elephant of North America.*)

Elephas primigenius, Blumenbach. In part, of numerous authors.

MASTODON GIGANTEUS, Cuvier. See numerous authors.

URSUS AMERICANUS (*fossilis*). Leidy: Proc. Ac. Nat. Sc., 1853, VI.

URSUS AMPLIDENS, Leidy: Proc. Ac. Nat. Sc., 1853, VI.

FELIS ATROX, Leidy: Trans. Am. Phil. Soc., 1852, X. 319.

PROCYON PRISCUS, Le Conte: Am. Journ. Sc., 1848, V. 106.

ANOMODON SNYDERI, Le Conte: Am. Journ. Sc., 1848, V. 106.

CASTOR FIBER (*fossilis*). Wyman: Am. Journ. Sc., 1850, X. 61.

CASTOROIDES OHIOENSIS, Foster: Second Ann. Rep. of the Geolog. Survey of Ohio, 1838, 80, 81; Wyman: Boston Journ. Nat. Hist. Soc., 1846, V. 385.

OROMYS ÆSOPI, Leidy: Proc. Ac. Nat. Sc., 1853, VI. 241.

MEGATHERIUM MIRABILE, Leidy: Proc. Ac. Nat. Sc., 1852, VI. 117.

Megatherium, Cuvier. Cooper: An. Lyc. Nat. Hist. of N. York, 1824, I. 114; Ibid., 1828, II. 267; Hodgson: Mem. on the Megatherium, 1846.

Megatherium Cuvieri, Desmarest. Harlan: Fauna Amer., 1825, 200.

MEGALONYX JEFFERSONII, Harlan: Fauna Amer., 1825, 201.

Megalonyx laqueatus, Harlan: Journ. Ac. Nat. Sc., 1838, VI. 269.

Aulaxodon s. Pleurodon, Harlan: Med. and Phys. Researches, 1835, 330.

MEGALONYX DISSIMILIS, Leidy: Proc. Ac. Nat. Sc., 1852, VI. 117.

---

[1] This may prove to be a new species, but it certainly is not the *Cervus americanus* of Harlan, as is supposed by Dr. De Kay, for the remains of the latter indicate an animal even greater in size than the Irish Elk.

MYLODON HARLANI, Owen: Zool. Voy. Beagle, Pt. I., 1840, 68.
Megalonyx laqueatus, Harlan: Med. and Phys. Researches, 1835, 334.
Orycterotherium Missouriense, Harlan: Proc. Am. Phil. Soc., 1841, II. 119; Am. Journ. Sc., 1843, XLIV. 69.
Orycterotherium Oregonensis, Perkins: Am. Journ. Sc., 1843, XLIV. 80.
EREPTODON PRISCUS, Leidy: Proc. Ac. Nat. Sc., 1853, V. 241.
EUBRADYS ANTIQUUS, Leidy: Ibid.
Megalonyx potens, Leidy: Proc. Ac. Nat. Sc., 1852, VI. 117.
DELPHINUS VERMONTANUS? Thompson: Am. Journ. Sc., 1850, XI. 256.
TRICHECUS VIRGINIANUS? Dekay: Nat. Hist. New York, 1842, Pt. I., Zool. Mam., 56.
Trichecus. Mitchell, Smith, and Cooper: An. Lyc. Nat. Hist. N. York, 1828, II. 271.
Trichecus rosmarus (*fossilis*). Harlan: Med. and Phys. Researches, 1835, 277.
MANATUS, Cuvier. Harlan: Journ. Ac. Nat. Sc., 1825, IV. 236; Med. and Phys. Researches, 1835, 278.
RORQUALIS AUSTRALIS (*fossilis*). Dekay: Nat. Hist. New York, 1842, Pt. I., Zool. Mam. 99.[1]

In addition to the species just enumerated, remains of numerous mammals and other vertebrates have been discovered, by Prof. S. F. Baird, in various caves of Pennsylvania and Virginia, and are now deposited in the Museum of the Smithsonian Institution.[2] The collection contains representatives of nearly all the larger recent mammals and turtles of the United States, together with a few extinct species.

The particular object of the present memoir is the description of a large and highly important collection of remains of mammalia and chelonia from an extensive Eocene deposit, which immediately overlies the Green Sand of the Cretaceous Period, in the Mauvaises Terres of Nebraska Territory.

The Mauvaises Terres, or Bad Lands, as they are named, constitute a district of country extending along the foot of the Black Hills, a spur of the Rocky Mountains, situated between the Platte, or Nebraska, and the Missouri Rivers, at the head of certain branches of the latter called the L'Eau-qui-court, White, Cheyenne, and Moreau Rivers.[3]

Dr. Owen, in describing this region, from notes of a visit made to it by Dr. John Evans, in his magnificent "Report of a Geological Survey of Wisconsin, Iowa, and Minnesota, and incidentally of a portion of Nebraska," observes that it presents one of the most extraordinary and picturesque sights that can be found in the whole Missouri country.[4]

---

[1] The following are erroneously reported as fossil remains:—
RHINOCEROIDES ALLEGHANIENSIS, Featherstonhaugh: Journ. of Geol. 1831, I. 10. This is no animal remain whatever, but is merely a fragment of stone. See De Blainville's Osteographie, article *Rhinoceros*, p. 172. Further confirmed by Dr. Isaac Hays and Mr. Isaac Lea, who have had an opportunity of inspecting the specimen.
OSTEOPERA PLATYCEPHALA, Harlan: Fauna Amer., 126. The cranium described under this name is now preserved in the Cabinet of the Academy of Natural Sciences, and without the slightest doubt belongs to the recent *Cœlogenys paca*, Rengger, of South America.
EQUUS CABALLUS?
Equus major, Dekay: Nat. Hist. New York, Pt. I., Zool. Mam., 108.
Equus curvidens, Owen. Leidy: Proc. Ac. Nat. Sc., 1847, III. 262.

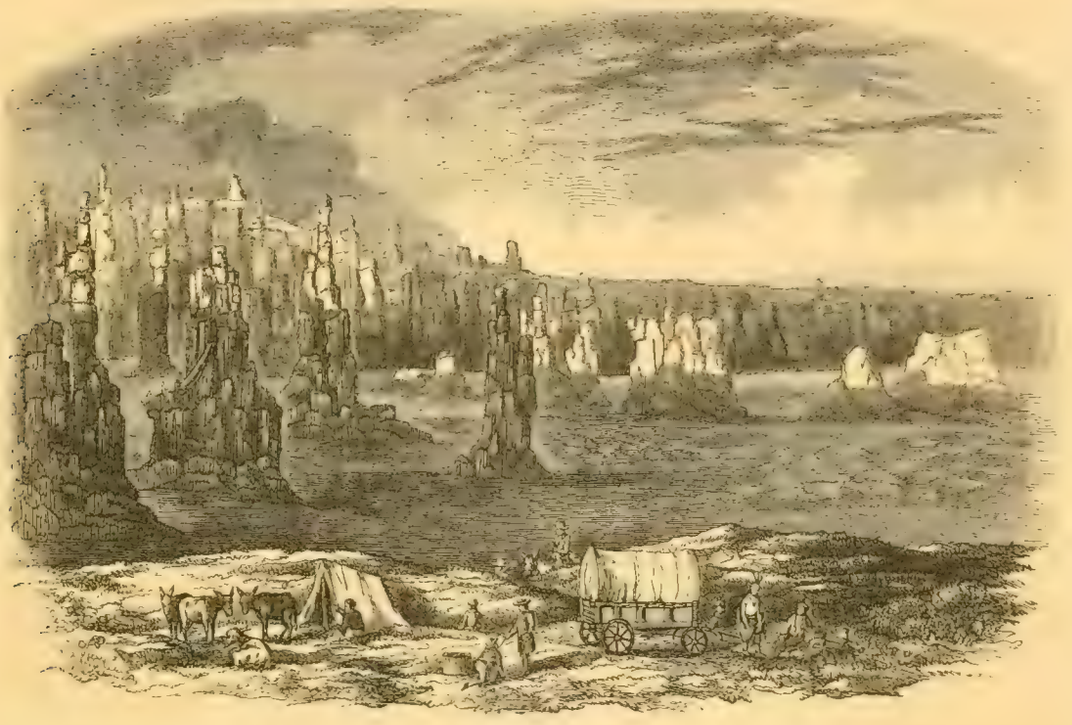
[2] See Proceedings of the American Association, at Cambridge, 1849, II. 352.

[3] See the map accompanying this memoir, for the use of which I am indebted to Dr. D. D. Owen.

[4] P. 196.

"From the high prairies that rise in the back-ground, by a series of terraces towards the spurs of the Rocky Mountains, the traveller looks down into an extensive valley, that may be said to constitute a world of its own, and which appears to have been formed, partly by an extensive vertical fault, partly by the long continued influence of denudation.

"The valley is about ninety miles in length, and thirty in breadth, and stretches away, westwardly, towards the base of the dark gloomy range of mountains, the Black Hills. Its most depressed portion is about three hundred feet below the general level of the surrounding country, and is covered by a soil, similar to that of the higher ground, supporting scanty grasses.



View of the Mauvaises Terres.—From the Geological Report of Dr. Owen.

"To the surrounding country, however, the Mauvaises Terres present the most striking contrast. From the uniform, monotonous, open prairie, the traveller suddenly descends, one or two hundred feet, into a valley that looks as if it had sunk away from the contiguous world; leaving standing, all over the surface, thousands of abrupt, irregular, prismatic, and columnar masses, frequently capped with irregular pyramids, and extending to a height of one or two hundred feet, or more.

"So thickly are these natural towers studded over the surface of this extraordinary region, that the traveller threads his way through deep, confined, labyrinthine passages, not unlike the narrow irregular streets and lanes of some quaint old town of the European continent. Viewed in the distance, indeed, these rocky piles, in their endless succession, assume the appearance of massive artificial struc-

tures, decked out with all the accessories of buttress and turret, arched doorway and clustered shaft, pinnacle, finial, and tapering spire.

"One might almost imagine he was approaching some magnificent city of the dead, where the labor and the genius of forgotten nations had left behind them a multitude of monuments of art and skill.

"On descending from the heights, however, and proceeding to thread this vast labyrinth, and inspect in detail its deep intricate recesses, the realities of the scene soon dissipate the delusions of the distance. The castellated forms which fancy had conjured up have vanished; and on every side appears bleak and barren desolation.

"Then, too, if the exploration be made in summer, the scorching rays of the sun, pouring down in the hundred defiles that conduct the wayfarer through this pathless waste, are reflected back from the white or ash-colored walls, that rise around unmitigated by a breath of air or the shelter of a solitary shrub.

"The drooping spirits of the scorched geologist are not permitted, however, to flag. The fossil treasures of the way, well repay its sultriness and fatigue. At every step, objects of the highest interest present themselves. Embedded in the debris, lie strewn, in the greatest profusion, relics of extinct animals. All speak of a fresh-water deposit of the early Tertiary Period, and disclose the former existence of most remarkable races, that roamed about in bygone ages high up in the valley of the Missouri, towards the sources of its western tributaries; where now pasture the Big Horn (*Ovis montana*) and the Buffalo (*Bison americanus*)."

Mr. Thaddeus A. Culbertson, who visited the Mauvaises Terres in 1850, under the auspices of the Smithsonian Institution, and made a good collection of its animal remains, has given a description of this remarkable country closely corresponding with that just detailed. In one part of his journal, he observes: "The road now lay over hills which became more steep and frequent as we approached the Bad Lands. These occasionally appeared in the distance, and never before did I see anything that so resembled a large city; so complete was this deception that I could point out the public buildings; one appeared to have a large dome, which might be the town hall; another, with a large angular top, suggested the idea of a court-house, or some other magnificent edifice for public purposes; and then appeared a row of palaces, great in number and superb in all their arrangements. Indeed, the thought frequently occurred as we rode along, that we were approaching a city of palaces; with everything upon the grandest scale, and adapted for giants, who might have ruled the huge animals, whose remains are there still, and not for pigmies, such as now inhabit the earth. Again and again, as from different positions this region was visible, thoughts of an immense city would arise in my mind, and I could almost fancy its din and bustle were occasionally borne upon the wind to my ear."[1]

The structure of the columnar rocks of the Bad Lands, according to the report of Dr. Evans, quoted in the work of Dr. Owen, before indicated, is as follows:—

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[1] Journal of an Expedition to the Mauvaises Terres and the Upper Missouri in 1850. Fifth An. Rep. of the Smiths. Inst., p. 84.

Section of Beds constituting the early tertiary (Eocene) of the Bad Lands (Mauvaises Terres).—(Numbered in the descending order.)

1. Ash-colored clay, cracking in the sun, containing silicious concretions 30 feet.
2. Compact white limestone . . . . . 3 "
3. Light-gray marly limestone . . . . . 8 "
4. Light-gray indurated silicious clay (not effervescent) . . . 30 "
5. Aggregate of small angular grains of quartz, or conglomerate, cemented by calcareous earth (slightly effervescent) . . . . . 8 "
6. Layer of quartz and chalcedony (probably only partial) . . 1 inch.
7. Light-gray indurated silicious clay, similar to number 4, but more calcareous, passing downwards into pale, flesh-colored, indurated, silicious, marly, limestone (effervescent), turtle, and bone bed . . . . 25 feet.
8. White and light-gray calcareous grit (slightly effervescent) . . 15 "
9. Similar aggregate to number 5, but coarser . . . . . 8 "
10. Light-green, indurated, argillaceous stratum (slightly effervescent), *Titanotherium* bed . . . . . 20 feet.

The extensive cemetery of eocene vertebrata in the Mauvaises Terres, or Bad Lands, of Nebraska, was first brought to our notice in a communication entitled *Description of a Fossil Maxillary Bone of a Palæotherium, from near White River*, published by Hiram A. Prout, M. D., of St. Louis, in the American Journal of Science and Arts, for 1847, page 248.

Nearly at the same time, Mr. J. S. Phillips, when on a visit to Chambersburg, Pennsylvania, observed in the possession of Dr. S. D. Culbertson, several remarkable mammalian fossils, which had been sent as curiosities from the Bad Lands by his nephew, Mr. Alexander Culbertson, of the American Fur Company. These specimens, at the suggestion of the late distinguished Dr. S. G. Morton, were obtained through Dr. John H. B. McClellan, a friend of Dr. Culbertson, and were obligingly placed in my hands for examination. A description of them was published in the Proceedings of the Academy of Natural Sciences, of Philadelphia, for 1847 and 1848; and they were afterwards presented by Alexander Culbertson to the Academy.

The attention of Dr. D. D. Owen having been directed to the interesting region whence the fossils were obtained, he requested Dr. John Evans, an assistant in the geological survey in which he was engaged, to pay it a visit. This gentleman brought home a magnificent collection of fossils, which form the basis of one of the chapters in the Report of Dr. Owen, before quoted.[1]

Through the instrumentality of Prof. S. F. Baird, who from the first fully appreciated the importance of a complete examination of the Mauvaises Terres and their animal remains, Mr. Thaddeus A. Culbertson, under the auspices of the Smith-

[1] Dr. J. Leidy's Memoir, p. 533, of the "Report of a Geolog. Surv. of Wisc., etc."

sonian Institution, visited the locality in 1850, and brought home a valuable additional collection of mammalian and chelonian fossils.

From a variety of favorable circumstances, but especially through important aid from the Smithsonian Institution, and Dr. D. D. Owen, I have been enabled personally to inspect all the animal remains brought from Nebraska, of which I have had any intimation. In commencing, then, with a description of the Eocene Fauna of Nebraska, the following collections were submitted to investigation.

1. The original fragment of a maxillary bone described by Dr. Prout, with the addition of several other important specimens. These were kindly loaned by Dr. Hiram A. Prout, of St. Louis.

2. A collection which accompanied the former, belonging to, and obligingly loaned by Prof. O'Loghland, of St. Louis.

3. Specimens presented by Alexander Culbertson, Esq., through Joseph Culbertson, Esq., to the Academy of Natural Sciences, of Philadelphia.

4. The collection made by Dr. John Evans, at the instigation of Dr. D. D. Owen, for the United States Government, and now belonging to the Smithsonian Institution.

5. A collection procured, as above mentioned, by Mr. Thaddeus A. Culbertson, for the Smithsonian Institution. Very important aid in making this collection was rendered by Mr. Alexander Culbertson.

6. A small but very excellent collection made by Captain Stewart Van Vliet, of the United States Army, and by him presented to the Smithsonian Institution. These specimens, though last received, were actually among the first collected, having been procured by him when on a journey from Fort Pierre to Fort Laramie, in company with Mr. Alexander Culbertson, who, on the same occasion, obtained the specimens first described by me.

Most of the specimens when received, were partially enveloped by, or had attached to them a hard, silicio-calcareous clay, of a dirty cream color; and the same material fills the cavities of the skulls and the interior of the turtle shells.

This matrix, according to Dr. D. D, Owen, has the following composition :—[1]

Water of absorption	HO	2.50
Flesh-colored silicious earth, insoluble in chlorohydric acid		33.00
Lime	CaO	30.90
Carbonic acid	CO_2	19.00
Sesquioxide of iron	Fe_2O_3	2.00
Alumina	Al_2O_3	1.00
Manganese	MnO	1.00
Magnesia	MgO	1.00
Phosphoric acid		1.80
Chlorine	Cl	0.44
Potash	KO	4.08
Soda and loss	NaO	3.28
		100.00

[1] Rep. of a Geolog. Surv. etc., p. 606.

A portion of the matrix attached to the bones of the *Titanotherium*, obtained from the lowest bed of the geological section, No. 10, p. 13, also analyzed by Dr. Owen, was found to be composed as follows:—[2]

Water	HO	4.00
Silica	SiO_3	59.00
Lime	CaO	10.00
Carbonic acid	CO_2	12.20
Sesquioxide of iron	Fe_2O_3	7.20
Alumina	Al_2O_3	4.20
Phosphoric acid		1.90
Chlorine	Cl	0.037
Sulphuric acid	SO_3	0.03
Alkalies and loss		1.433
		100.000

The bones, unlike those of the gypsum quarries of Montmartre, (which are of the same age but not mineralized) are as completely petrified as any found in the most favorable circumstances. Most usually they are exceedingly hard, compact, and heavy, and only rarely have they become friable. The cellular, vascular, and medullary cavities are filled with mineral matter, in most instances, consisting of crystallized or amorphous silex or chalcedony, which is sometimes botryoidal in its arrangement in the larger cavities.

The bones are preserved in very various degrees of integrity, some being beautifully perfect, whilst others are crushed or otherwise fractured, the crevices being filled with the ordinary matrix, or with a harder mineral matter. The latter evidently were subjected to violence while enveloped in a soft mud which now constitutes the matrix; for in most instances in which the fragments have been widely separated, they still retain their proper relative position to one another.

The teeth, where they exist, are usually preserved quite perfect, and in all cases their pulp cavities are filled with dense amorphous, or with crystallized silex.

The dentine is commonly of a cream color, or pure white, but occasionally it is tinged with a roseate hue; and in most cases where exposed from the enamel having been worn off, it is covered by a lamina of compact peroxide of iron. Its texture is firm, though more friable than in the recent condition. The enamel is well preserved in texture, but in every instance is stained. Its color passes from translucent light brown resembling horn, through different shades of brown, to black with a brown or bluish tinge. Its surface is highly lustrous, and in those cases in which it is dark in color, resembles polished steel.

The bones are cream white, yellowish, brownish, brown, and iron gray, and most frequently have a slightly polished surface. Very often a thin layer of brown oxide of iron adheres to the latter, and is difficult to detach, without removing a portion of the osseous structure.

None of the specimens have the appearance of being water worn, or rolled, but all the teeth and processes of bone, when entire, exhibit all their original sharpness

[1] Rep. of a Geolog. Surv. etc., p. 606.

of outline, indicating that the carcasses of the animals to which they belonged decayed upon a soft, muddy bottom of a lake or similar body of water.

An analysis of portions of some of the bones and teeth having been made by Dr. Francis B. Greene, under the immediate inspection of Dr. F. A. Genth, at the request of Dr. D. D. Owen and myself, the following results were obtained :—

Specimen 1. Fragment of an os femoris of *Titanotherium*. This was compact, with a subconchoidal fracture, and tough. Its hardness was = 4.5; the sp. gr. = 2.870. Lustre resinous. Color brown; opaque. On heating, it eliminated an ammoniacal water, together with the odor of burnt horn.

Specimen 2. Fragment of a tibia of *Archæotherium*. This was compact, and presented an uneven, somewhat splintery, fracture. Its hardness was = 4.; the sp. gr. = 2.826. Lustre pearly. Color pinkish white; opaque. When heated in contact with the air, it assumed a green tint from the development of manganic acid.

Specimen 3. Fragment of enamel from a molar tooth of *Titanotherium*. Appearance fibrous, with an uneven fracture, and very tough. Its hardness was = 4.7; the sp. gr. = 4.7. Lustre upon the surface subvitreous, that of the fibres pearly. Color bluish gray, opaque.

Specimen 4. Fragment of dentine, from a molar tooth of *Titanotherium*. It was compact, and had an uneven, somewhat subconchoidal fracture. Its hardness was = 2.5; the sp. gr. = 2.935. Lustre dull. Color white, with gray spots and black streaks; opaque. On heating, in contact with the air, it assumed a greenish tint.

COMPOSITION.

		Spec. 1.	Spec. 2.	Spec. 3.	Spec. 4.
Sesquioxide of iron	Fe_2O_3	1.777	trace	trace	trace
Oxide of manganese	MnO	trace	trace	trace	trace
Magnesia	MgO	0.348	1.140	0.219	0.53
Lime	CaO	49.837	47.052	51.872	49.82
Fluoride of calcium	CaFl	0.716	5.086	0.099	2.90
Baryta	BaO	0.359	1.131	——	——
Soda	NaO	1.134	1.572	1.288	0.75
Potassa	KO	0.317	0.276	0.239	0.23
Silica	SiO_3	0.135	0.259	0.611	0.79
Sulphuric acid	SO_3	1.067	2.200	1.011	1.51
Phosphoric acid	PO_5	34.148	32.957	39.348	36.10
Carbonic acid	CO_2	4.088	2.270	3.165	2.83
Chlorine	Cl	trace	trace	trace	trace
Water	HO	2.048	1.971	0.626	2.10
Organic matter		5.682	4.086	2.538	2.66
		101.656	100.000	101.016	100.22

Or, the composition may be considered thus :—

		Spec. 1.	Spec. 2.	Spec. 3.	Spec. 4.
Phosphate of iron	$2Fe_2O_3,3PO_5$	2.821	——	——	——
" magnesia	$3MgO,PO_5$	0.770	2.099	0.403	0.98
" lime	$3CaO,PO_5$	69.685	68.582	83.835	77.81
" soda	$2NaO,PO_5$	1.415	1.079	1.413	——
Sulphate of baryta	BaO,SO_3	0.547	1.723	——	——
" soda	NaO,SO_3	1.083	2.443	1.437	1.71
" potassa	KO,SO_3	0.587	0.510	0.442	0.43
" lime	CaO,SO_3	——	——	——	0.60
Silicate of lime	$3CaO,SiO_3$	0.382	0.732	1.727	2.23
Carbonate of lime	CaO,CO_2	9.315	5.172	7.212	6.45
Lime	CaO	6.605	6.517	1.284	2.35
Fluoride of calcium	CaFl	0.716	5.086	0.099	2.90
Water	HO	2.048	1.971	0.626	2.10
Organic matter		5.682	4.086	2.538	2.66
		101.656	100.000	101.016	100.22[1]

Cuvier, in speaking of the remains of mammalia in the gypsum quarries of the Paris basin observes, "on peut s'étonner que dans une contrée aussi étendue que celle qu'occupent nos carriéres, et qui a plus de vingt lieues de l'est à l'ouest on n'ait presque trouvé que des os d'animaux d'une seule famille, et que le petit nombre d'espèces étrangères à cette famille principale, y soient d'une rareté extrême." The distinguished author infers from this a condition analogous to that presented in our day by Australia. More recent researches, however, have shown that in the single family alluded to, the *Pachydermata*, he included members really belonging to one of the other Cuvierian families; for the *Anoplotherium* and *Dichobune* are now generally considered to have been true ruminating animals.

With a single exception, all the species of extinct mammalia, which have yet been obtained from Nebraska, belong to the *Ungulata*, and, as in the case of those of the Paris basin above referred to, consist of *Ruminantia* and *Pachydermata*.

The great order of *Ungulata*, or hoofed mammalia, according to the idea originally expressed by Cuvier, and confirmed by De Blainville, but more especially by Owen, is divisible into two distinct sub-orders, the *Paridigitata* or even-toed ungulates, and the *Imparidigitata*, or uneven-toed ungulates.

The sub-order *Paridigitata* may be divided into the families *Ruminantia* and *Ordinaria*.

The *Ruminantia* are further divisible into sub-families as follows:—

1. Those which are hornless, and have incisors and canines in both jaws; as *Anoplotherium*, *Macrauchenia*, *Dichobune*, *Chalicotherium*, etc.

2. Those which are hornless, and have canines and an incomplete series of incisors or none at all, in the upper jaw; as *Camelus*, *Auchenia*, *Moschus*, *Dorcatherium*, etc.

3. Those which have processes of the os frontis, or have antlers, in one or both sexes, and have or have not upper canines, or have them in a rudimentary condition, and which are without upper incisors; as *Cervus*, *Cameloepardalis*, etc.

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[1] Proc. Acad. Nat. Sc., VI. 292.

4. Those which possess true horns, and have neither upper canines nor incisors; as *Antilope, Bos, Ovis,* etc.

The *Paridigitata ordinaria* are represented by *Sus, Dicotyles, Hippopotamus, Chœropotamus, Anthracotherium, Hyracotherium,* etc.

The second sub-order of *Ungulata* is divisible into the following families:—

Solipedia, represented by *Equus, Hipparion, Anchitherium,* etc.

Ordinaria, to which belong *Rhinoceros, Tapirus, Palæotherium,* etc.

Proboscidia, containing *Elephas* and *Mastodon.*

Of the mammalia from Nebraska, which will be described according to the preceding arrangement, there are seven species of four genera which belong to the *Ruminantia,* two species of one genus to the *Paridigitata ordinaria,* one species to the *Solipedia,* and four species of three genera to the *Imparidigitata ordinaria.*

The exceptional case above referred to, belonging to a different order from the *Ungulata,* is a carnivorous animal of the feline genus *Machairodus.*

The chelonian fossils from Nebraska, of which there are five species, belong all to the genus *Testudo.*

MAMMALIA.

CHAPTER I.

DESCRIPTIONS OF UNGULATA PARIDIGITATA.

Fam. 1.—RUMINANTIA.

Gen. **POEBROTHERIUM,** LEIDY.

Poebrotherium Wilsonii, LEIDY.

(PLATE I. Figs. 1–4.)

Poebrotherium Wilsonii, Leidy: Proceedings of the Academy of Natural Sciences of Philadelphia, 1847, III. 322; Owen's Rep. of a Geol. Surv. of Wisc., etc., 1852, 571.

Poebrotherium is a peculiar genus of ruminants, among recent animals most nearly allied to the Musks, and probably belongs to the second sub-family according to the characters before indicated.

The species *Poebrotherium Wilsonii* was established upon the greater portion of a skull, which was the first mammalian fossil, sent to the Academy of Natural Sciences of Philadelphia, from the eocene beds of Nebraska. It was presented by Mr. Alexander Culbertson, of Chambersburg, Pennsylvania, and, when first received, excited great interest among the members of the Academy, as being an indication of the rich palæontological treasures since derived from the same locality.

The specimen has lost the symphysis of the lower jaw, the end of the nose, one zygoma, the upper part of the face, and the upper and posterior part of the cranium. It is also much fractured and fissured; but the portions of it which remain appear to have very well retained their original relative position.

It belonged to an individual just reaching adult age; the permanent true molars having protruded, but none of the deciduous molars having been shed. In the upper jaw the molars are preserved on both sides, but several of those upon the left side are broken. This series consists of the three permanent true molars and three deciduous molars in a continuous row, and the first permanent premolar separated by a hiatus from the others. (Pl. I. Figs. 1, 3.) In the lower jaw, on the left side, are preserved five, and on the right side six teeth, viz., three permanent true molars, and three deciduous molars, forming a continuous row. (Figs. 1, 4.)

When the specimen was received, the right side of the lower jaw contained a fragment of a fang, separated from the remaining molars by a hiatus, and situated just in advance of the position of the first permanent premolar above, with which it most probably corresponded.

The form of the head, if restored, would probably most approach that of the existing Musks, or the extinct *Dorcatherium*, Kaup, from the Middle Tertiary Formations of Europe. The face is relatively longer than in either of these genera, and is also more advanced in position; for in *Poebrotherium* the anterior margin of the orbit is on a line with the middle of the penultimate true molar, whereas in *Dorcatherium* it is in advance of this, and in the Musks it is anterior to the first.

At the side of the nose, the face is depressed into a remarkably deep concavity, at the bottom of which the ossa maxillaria of the two sides are nearly in contact; and the face, in this position, is only about two lines and a half in diameter. (Figs. 1, 2.) The depression may, to some extent, be the result of accident after the death of the animal, for the specimen is fractured; the parts, however, generally appear to have retained their natural position.

Dorcatherium also presents a concavity holding nearly the same relative position; but, in consequence of the distance between the orbit and the bottom of the canine alveolus being comparatively short in this genus, the depression is close to the orbit; whereas, in *Poebrotherium* it is far advanced by reason of the prolongation of the face, which converges from the margin of the orbit to the bottom of the concavity.

Anteriorly, in the specimen, the concavity is abruptly intruded upon by a bulging of the face, apparently produced by a canine alveolus like that of the *Moschus moschiferus* and the *Dorcatherium*.

Below the concavity of the side of the nose, the face becomes rather abruptly, vertically convex; and here, above the anterior fangs of the last temporary molar, less advanced than in the Musks, is situated the exit of the infra-orbital canal.

The anterior and inferior margins of the orbit remain, and show it to have been large and subcircular, as in *Dorcatherium*, and to have had a direction outward and slightly upward, but apparently not at all forward. The margin of the orbit, anteriorly and inferiorly, is everted, and is most prominent at the lachrymal border.

The malar bone below the orbit is about three lines deep, and, except its slightly everted orbital margin, is vertical in its position, so that its lower border is situated considerably exterior to the alveolar processes. That border is nearly on a level with the edge of these processes, and the maxillo-malar suture curves upward and forward from near their edge, about the position of the middle of the last molar tooth. Anteriorly to the orbit, the malar bone rises for nearly half an inch above its inferior margin, and is there from four and a half to five and a half lines wide.

The lachrymal bone externally is six lines broad, and forms part of the slope of the face converging to the bottom of the concavity at the side of the nose, but presents itself no disposition to the formation of a lachrymal sinus. Its orbital face, near the margin, is pierced by an infundibular orifice about one line wide to the ductus ad nasum.

The only parts preserved and visible of the base of the cranium, in the specimen, are the auditory bullæ, separated by the body of the sphenoid bone. These are remarkable for their great size and position. Relatively they are not longer than in the Musks, but their transverse and antero-posterior diameters are rather greater. They are also more vertical in their position than in the Musks, and are so situated that their postero-external portion projects considerably exterior to the ramus of the lower jaw, filling up nearly a concavity formed by its posterior margin. The length of the bullæ from the meatus auditorius is eleven lines, the transverse diameter posteriorly nine lines, and the antero-posterior diameter an inch. Externally they are convex, and converge forwards within the position of the ramus of the lower jaw; internally they are vertical and slightly convex, or nearly plane; posteriorly they inclose the stylal pit; and postero-internally they present a broad irregular surface, which abuts against the paramastoid process. The space separating the bullæ, or the width of the sphenoidal body between them, is about five lines. (Fig. 1.)

The auditory process resembles that of the Musks, and the meatus auditorius externus, which holds the same relative position as in these, is subcircular, and about a line in diameter.

The glenoid articulation, so far as can be ascertained by viewing its position with the condyle of the lower jaw in contact, is much like that of the Musks, but appears rather more concave.

Inferior Maxilla.—The form of the lower jaw in *Dorcatherium* is very similar to that of the recent Musks, but is very peculiar in *Poebrotherium*. In this the base is much more nearly horizontal, and when placed upon a plane surface touches it at the angle and middle, and the anterior portion, which curves downwards from the position of the third premolar to the symphysis, also nearly reaches the same level. (Fig. 1.)

The outer surface of the bone below the true molars is convex, but below the premolars is nearly plane and deeper than in the former position. The alveolar margin rapidly ascends posteriorly from the position of the second true molar, and descends in advance of the second premolar.

The ramus is remarkable for its breadth, and the possession of an angular apophysis, as in the Camel, carnivora, and most rodentia. The process in position and form is intermediate to that of the Camel and Rabbit. From its point a thin convex edge, corresponding to the technical angle, descends to the base of the jaw, and a concavity, which in a great measure is occupied by the auditory bulla, ascends to the condyle.

The relation of the condyle and coronoid process is about the same as in the Musks, but below the notch separating them, the ramus is depressed relatively as much as in the Peccary, a peculiarity in which the genus differs from all existing ruminants.

The condyle externally has nearly the same form as in the Musks, and as far as can be seen in the specimen; its articular surface appears to be a little more convex than in those animals.

The coronoid process is relatively broad, and curves upwards as in the Musks.

Its extremity is broken in the specimen. The symphysis also is broken away, but it appears to have commenced from behind about four lines in advance of the second premolar, and the anterior mental foramen is situated just above this portion of it.

Dentition.—I think it probable that the permanent dentition of *Poebrotherium* was equal to the following formula:—

$$i.\ \frac{0?\ \ 0?}{4?\ \ 4?}\ c.\ \frac{1?\ \ 1?}{0?\ \ 0?}\ p.m.\ \frac{4\ \ 4}{4\ \ 4}\ m.\ \frac{3\ \ 3}{3\ \ 3} = 38.$$

In the specimen, the symphysis with its teeth is broken away; and a portion only apparently of the upper canine alveolus remains.

Superior Molars.—The upper teeth, in the specimen, consist of the three permanent true molars, fully protruded, and the three temporary molars, forming together a closed row, and separated from this by a hiatus with an acute concave margin about four lines long, is, what I suspect to be, the first permanent premolar, which had no predecessor. (Figs. 1, 3.)

The permanent true molars resemble those of the Musks, but their constituent lobes possess much less prominent summits. The inner lobes also are less angular, but more convex internally, and the outer lobes are much less prominent in the same direction. The outer lobes of each true molar, in the Musks, are separated by a narrow cleft, but in *Poebrotherium* they are separated only by a longitudinal ridge, which is the most prominent of those existing externally. The median ridge of each lobe externally is the most prominent and convex in the Musks, but is relatively narrow in *Poebrotherium*, and the intervening spaces are more flat in this genus.

In the specimen under consideration, the last molar had been but a short time fully protruded, the enamel being worn only from the summit of its postero-internal lobe, and remaining nearly intact upon the postero-external. The summits of all the other lobes of the true molars present narrow tracts of exposed dentine surrounding the interlobular pits of enamel.

The temporary molars, also, have a very great resemblance to those of the Musks. The last of the series is like the permanent true molars, and in the specimen the enamel has been worn from the masticating surface, except a small crescentic islet between the posterior pair of lobes.

The second temporary premolar in the specimen has its enamelled triturating surface obliterated, and in its present condition is constituted by a wide posterior lobe, the result of the confluence of an original transverse pair, and a narrower anterior lobe with a pyramidal summit, which does not distinctly appear to be formed from the association of an antero-posterior pair, such as exists in the corresponding tooth of the Musks. Externally this tooth presents three convex prominences, separated by concave depressions.

The first temporary premolar has a simple, broad, oblong, trenchant crown, which is most prominent at its anterior part. It is convex externally, and the enamel internally is worn off in a sloping manner.

The first permanent premolar, which, as before observed, is removed from the others by a hiatus, has a simple oblong, trenchant crown like that last described,

but is longest or most prominent at the middle, is convex externally, and sloping plane internally, and is inserted in the jaw by two diverging fangs.

Inferior Molars.—(Figs. 1, 4.) The lower teeth, preserved in the specimen, consist of the permanent true molars, and the three temporary molars. The former are remarkable for the simplicity of their lobes, and these, as in the case of those above, have not as prominent summits as are found in the Musks. The internal surface of their inner lobes is vertical and plane in comparison with what it is in the Musks and other ruminants, and its longitudinal ridges are but slightly elevated above the intervening spaces. The external surface of these lobes is quite plane and nearly parallel with the internal.

The outer lobes are vertically prismoid with the anterior surface broader than the posterior, and the internal surface more vertical than in the Musks or Deer. The extremities of the crescentic summits join the corresponding margins of the inner lobes, and there is no disposition to the bifurcation of the posterior horn of the antero-external lobes as in the Musks.

Each transverse pair of lobes, in the specimen, presents a trilateral pit of enamel surrounded by a narrow tract of exposed dentine.

The fifth lobe of the last molar is a simple, thin, enamelled plate, with a trenchant edge.

The last temporary molar, as in all ruminants, is composed of three pairs of lobes; but, in the specimen, from the obliteration of the interlobular enamel pits, it rather consists of three antero-posterior prismoid lobes.

The two temporary premolars, in the broad trenchant character of their crown, resemble those of the Musks. Their trenchant margin rises to the middle of the teeth, the external surface is elevated into three slight convexities, and the inner surface is convex posteriorly, but is depressed anteriorly. The margin of the second premolar is broadest posteriorly, and is worn off in this position in the specimen, and the anterior fifth of the tooth bends within that preceding it. As before observed, when the specimen was first received, a fragment of the first permanent premolar remained in the lower jaw, situated about five lines in advance of the first temporary molar.

This species is named in honor of Dr. Thomas B. Wilson, of Philadelphia, a distinguished patron of the natural sciences.

MEASUREMENTS.

	Inches.	Lines.
Distance from meatus auditorius to anterior part of first permanent premolar	4	9
Distance from meatus auditorius to infra-orbital foramen	3	1
Diameter of orbit from lower part of post-orbital arch to lachrymal margin	1	2
Breadth at meatus auditorius	1	9
Breadth at auditory bulla	2	1
Breadth at malar bone below orbit	2	4
Breadth at infra-orbitar foramen	1	2
Breadth above first permanent premolar		7½
Breadth above middle true molar	1	10
Height of orbit from base of lower jaw	1	8
Height of lower jaw at condyle	1	11
Height of lower jaw at middle true molar		7

	Inches.	Lines.
Height of lower jaw at first temporary premolar		7
Height of angular apophysis		10
Distance from coronoid process to anterior mental foramen	4	4
Length of upper series of six molars	2	6
Length of lower series of six molars	2	8

	GREATEST DIAMETER.	
	Antero-posterior.	Transverse.
Seventh upper molar	7 lines.	6 lines.
Sixth upper molar	6½ "	5¾ "
Fifth upper molar	5½ "	5 "
Third temporary molar	5 "	4 "
Second temporary molar	5 "	3 "
First temporary molar	4½ "	1 "
First permanent premolar	3½ "	1 "
Seventh lower molar	9 "	3¾ "
Sixth lower molar	6½ "	
Fifth lower molar	5½ "	
Third temporary molar	6 "	2½ "
Second temporary molar	5 "	1½ "
First temporary molar	4 "	1 "

AGRIOCHOERUS, Leidy.

Agriochoerus antiquus, Leidy.

(Plate I. Figs. 5–10.)

Agriochoerus antiquus, Leidy: Proc. Acad. Nat. Sci., 1850, V. 121; Owen's Rep. of a Geol. Surv. of Wisc., etc., 571.

Agriochoerus is a remarkable and very peculiar genus of ungulata, representing a type which occupies a position in the wide physiological interval existing between recent ruminants and the anomalous *Anoplotherium*.

It was first established in the Proceedings of the Academy of Natural Sciences of Philadelphia, for 1850, upon a portion of a skull, and several fragments of jaws with teeth, received from my friend, Dr. Hiram A. Prout, of St. Louis.

Of the species characterized under the name of *Agriochoerus antiquus*, I have had the opportunity of studying the following specimens:—

1. A much mutilated face, with the forehead, and portions of both sides of the lower jaw, apparently of an adult individual. The upper jaw contains upon one side the posterior five molars, and upon the other side the posterior six molars. Both fragments of the lower jaw contain the posterior five molars. The first true molar is only slightly worn, while the others have hardly yet been affected by trituration. Received from Dr. Prout. (Pl. I., Figs. 5–8.)

2. Two fragments of the upper maxillæ, containing each the last two true molars, and a fragment of the lower jaw containing the anterior two true molars. These apparently belonged to the same and an older individual than the former. Received from Dr. Prout. (Figs. 9, 10.)

Description of the portion of a Skull.—Viewed from above, the anterior portion of the skull is nearly equilateral triangular, the sides of the face converging in a nearly

straight line from the posterior part of the orbit to the most anterior of the molars in the specimen. Viewed laterally (Fig. 5), it is remarkable for the lowness of the forehead and the parallelism of its upper part with the alveolar margin.

The forehead is broad, and between the anterior part of the orbits is convex, but between the posterior part, at its middle half, is flat or slightly depressed, and upon the post-orbitar processes is rather abruptly depressed.

The posterior part of the os frontis, in the specimen, has a small fragment of the ossa parietalia attached on each side, and between these it is convergent backward to where it is broken off, evidently indicating it to have been pointed and received into a notch of the parietalia as in the Camel and *Merycopotamus*. Anteriorly, the os frontis, though broken, is easily perceived to have terminated in angular processes between the ossa lachrymalia and nasi.

The remains of the frontal suture existing in the specimen, are distinct and zig-zag posteriorly, but straight and a little out of the normal course anteriorly.

About a line on each side of the frontal suture, in a position corresponding to the anterior third of the orbit and ten lines from its margin, is a small supra-orbitar foramen.

No portions of the nasal bones are preserved, and the notch of the os frontis, for the reception of their posterior extremity, is too much broken to ascertain their limits in this direction, but they appear to have extended a little posterior to the position of the anterior orbital margin.

The orbital entrance is open posteriorly as in *Anoplotherium*, but is relatively larger than in this, and its plane is directed outward and as much upward almost as in feline animals; but not so much forward as in the Deer, though rather more so than in the Musks. In form it is subcircular, and is about one inch in diameter.

The post-orbital processes of the os frontis and os malæ are six lines and three-fourths distant from each other, and are thick, compressed, conoidal, and pointed. That of the former bone is directed outward and downward, that of the latter upward, inward, and slightly anterior, and its point is about four lines external to the one above.

The lachrymal margin is partially broken, but it appears to have been only slightly prominent. The facial surface of the lachrymal bone is seven and a half lines in vertical diameter, and is a feebly depressed inclined plane, on the same level nearly as the orbital entrance.

The malar bone, compared with that of recent ruminants, is robust, and its external face, below the orbit, is vertically slightly convex. Antero-posteriorly it is convex, and its anterior limit is on a line with the first true molar tooth.

The superior maxillary bone, from the position of the malar bone forward and upward, as far as it is preserved in the specimen, is prominent and convex, and below this upon the alveoli is vertically convex. The infra-orbitar foramen is vertically oval and directed forward, and is situated above the hinder fang of the penultimate premolar an inch in advance of the orbit.

The hard palate, for the most part, is obscured by a very hard matrix, to remove which would endanger the specimen; but where exposed, between the anterior of the premolars, it is remarkable on account of the very great degree of inclination

of the two sides; its median suture being about five lines above the alveolar margin. (Fig. 6.)

Inferior Maxilla.—The two fragments of lower jaw, preserved in connection with the specimen just described, and comprising as much of the body of each side as contains the hinder five molars, present pretty much the same form as the corresponding portion of the jaw of the Camel, but are relatively deeper and less convex externally. (Fig. 5.)

The alveoli have a remarkable degree of descent forward in relation to the base of the jaw; the depth of the bone below the posterior lobe of the last molar being twenty-one lines, whilst it is only eleven lines below the last premolar.

Internally the lower jaw is much more convex than externally, especially in advance of the first true molar, and also posterior to this upon the alveolar portion of the bone.

Just above the thick, rounded base of the jaw internally, and below the position of the first true molar, a concavity commences, which gradually expands and deepens to a line with the posterior lobe of the last molar, when it abruptly increases and then continues to the broken margin of the specimen, so that it is probable the technical angle of the jaw within is deeply concave, as in the Tapir.

A little more than half way below the position of the last premolar externally is a small foramen directed backward, which is probably an offset from the inferior dental canal.

Dentition.—The molar teeth of *Agriochoerus* are certainly ruminant in their type, and the true molars in both jaws are constructed upon the same pattern as those of all recent ruminants, each being composed of two symmetrical pairs of demiconoidal lobes, with an additional odd lobe to the last lower molar. In the specimen above described, the posterior six molars are preserved in the upper jaw, and the posterior five in the lower jaw.

The molars in both jaws successively decrease in size from behind forward. Those above, on the two sides, are nearly parallel internally, and from thirteen to fourteen lines apart, but externally their line is convergent forward.

Superior Molars.—(Figs. 5, 6–10.) The upper true molars resemble very closely the corresponding teeth of *Hyopotamus* deprived of their anterior median or accessory lobe. As in this genus, their transverse diameter is greater than that antero-posteriorly; the result apparently of the expansion of the teeth from the condition in which they exist in the recent ruminants generally. The lobes are low and spread wide apart, and the interlobular spaces are broad and shallow; thus the perpendicular height of the outer lobes of the last molar is four lines, and the distance between the summits of the anterior pair of lobes is three lines.

The outer lobes conjoin externally to form a prominent median convexity, and another, similar but not quite so large, is formed by the union of the anterior angle of the antero-external lobe with the contiguous prolonged arm of the summit of the antero-internal lobe. The surface of the outer lobes, between the external convexities, is transversely concave with the feeblest degree of median elevation, and inclines very much inward. Internally the outer lobes are convex and nearly vertical.

The inner lobes are smaller than those external, are convex internally, and concave externally with a slight median elevation. The extremities of the summits extend around the base internally of the outer lobes, except that posterior of the antero-internal lobe, which ceases abruptly at its arrival in the transverse valley of the tooth.

Constituent portions of a basal ridge, feebly developed, exist principally between the bases of the inner lobes, and anteriorly and posteriorly.

The fourth premolar is quite peculiar, and rather resembles a last deciduous molar than the permanent premolars of ordinary ruminants. It consists of two pairs of lobes like those of the true molars, but the postero-internal lobe is in a rudimentary condition, consisting of a small pyramidal tubercle occupying the normal position. The prominence externally produced by the confluence of the outer lobes is relatively not so large as in the true molars, but otherwise the principal lobes have the same form.

The third premolar consists of one large trihedral pointed lobe, with a relatively small pyramidal lobe, situated at the base of its postero-internal face. The latter lobe is broken in the specimen. The external face of the former is the broadest, is slightly convex, and is prominent in the median line. The inner faces are sloping, and that posteriorly is concave.

The second premolar has nearly the same form as that last described. Its principal lobe is relatively less broad, and its external face is more convex. A rudimentary lobe, which apparently existed at the base of the postero-internal face of the principal lobe, is broken away in the specimen.

The upper true molars are implanted by four fangs; the last premolar by three; and those in advance by two. The fangs of the anterior premolars, and the outer ones of the last premolar and the true molars, present a remarkable curve outward in their course downward.

Inferior molars.—(Figs. 7–9.) The outer lobes of the lower true molars are larger than those within, but do not rise quite so high. Their internal face is concave and slightly elevated in the median line. Externally they are conoidal, are confluent at the base, are without intervening portions of a basal ridge, and are slightly spread outwardly towards their lateral margins.

The anterior extremity of the summit of the antero-external lobe joins the contiguous margin of the lobe within; its posterior extremity in association with that anterior of the summit of the postero-external lobe turns upward and becomes confluent with the posterior part of the external face of the antero-internal lobe; and the posterior extremity of the postero-external lobe, except that of the last molar, bifurcates, one portion connecting itself with the posterior part of the outer face of the postero-internal lobe, the other with the posterior margin of the same lobe.

The inner lobes externally are convex and nearly vertical, and internally are most prominent in the median line, and have their angles everted into short, prominent, divergent folds.

The fifth lobe of the last molar is about the size of those external, and in section is oval. Its pointed summit descends by a pair of U like arms, one of which joins

the margin of the internal of the posterior pair of lobes, the other the contiguous extremity of the summit of the inner of the same pair of lobes.

The fourth premolar, like the true molars and the corresponding tooth of the upper jaw, also has four lobes. Those external have the same form as in the true molars, but that anterior is larger than the one posterior. The inner lobes are reduced representatives of those homologous in the true molars, and still preserve the same form, but as they retain their connection with one another, they are placed at the posterior three-fourths of the position of the tooth.

The third premolar is formed by a single, large, broad, demiconoidal crown, in which, however, may be traced a constitution of two outer lobes corresponding to those of the true molars, the posterior of which has become almost entirely fused with the anterior, but is still distinguishable by a depressed line externally, and a well marked *cul-de-sac* internally.

All the inferior molars have two fangs, and in the last of the series the posterior consists of a confluent pair.

The enamel upon the teeth described is everywhere smooth, or is only very slightly corrugated.

MEASUREMENTS.

	Inches.	Lines.
Breadth of face from one malar bone to the other, posterior to the orbits	4	
Breadth of forehead at post-orbital processes of os frontis	2	4
Distance between the infra-orbital foramina	1	6½
Diameter of the orbits	1	
Height of forehead above the alveolar margin	1	10
Distance between the posterior molars anteriorly	1	2
Distance between the third premolars	1	2
Length of line of the posterior six superior molars	3	
Length of line of the five inferior molars	3	
Length of line of superior true molars	1	10
Length of line of inferior true molars	2	1½
Greatest antero-posterior diameter of the posterior superior molar		9
Greatest transverse diameter of the posterior superior molar		10½
Greatest height of the posterior superior molar		3½
Greatest antero-posterior diameter of first superior true molar		7¼
Greatest transverse diameter of first superior molar		8
Greatest antero-posterior diameter of fourth premolar		6
Greatest transverse diameter of fourth premolar		6½
Greatest antero-posterior diameter of second premolar		4½
Greatest transverse diameter of second premolar		3
Height of the second premolar		3½
Antero-posterior diameter of posterior inferior molar	1	
Transverse diameter of posterior inferior molar		6
Antero-posterior diameter of first true molar		6½
Transverse diameter of first true molar		4½
Antero-posterior diameter of fourth premolar		6½
Transverse diameter of fourth premolar		4
Antero-posterior diameter of third premolar		4½
Transverse diameter of third premolar		3

OREODON.

(Plates II.—VI.)

In the Proceedings of the Academy of Natural Sciences of Philadelphia for 1848, I described two fragments of an upper and a lower jaw of an extinct ungulate animal, from the Bad Lands of Nebraska Territory, presented to the Academy by Mr. Alexander Culbertson. The fragment of an upper jaw contained the last two molars, that of the lower jaw the three true molars, and from the form of the teeth I characterized the animal under the name of *Merycoidodon Culbertsonii.*

In 1851 I received from the Smithsonian Institution, and from Dr. Hiram A. Prout, of St Louis, several fragments of skulls and jaws, obtained from the same locality as the former. These contained the same form of true molars; but, being misled by a fragment of the face of a young animal containing a portion of the first permanent premolar, followed by the entire first, and portions of the second and third deciduous molars, in a verbal communication to the Academy,[1] I referred the specimens to two other distinct genera, to one of which the name *Oreodon* was given, and to the other that of *Cotylops.*

All these have since been satisfactorily determined to belong to a single genus, for which I desire to retain the name *Oreodon*, in preference to *Merycoidodon;* for all the anatomical characters of the animal indicate it to have been a true ruminant, and not merely like one in the form of its molar teeth.

Oreodon is a remarkable and very peculiar genus of ruminant ungulates, constituting one of the links necessary to fill up the very wide gap between existing ruminants and that exceedingly aberrant form of the same family, the extinct *Anoplotherium* of Europe and Asia.

Of this genus I have been enabled to examine crania, more or less perfect, and fragments of others; and teeth of numerous individuals of at least two, and probably three distinct species, and can render our knowledge of the head of the animal almost complete.

Description of the Skull.—The form of the skull of *Oreodon* is so peculiar that I know of none among existing ungulates with which to compare it nearer than that of the Camel; and yet this only approaches it in the form of the cranium proper. Generally it has most resemblance to that of *Anoplotherium*, but from this it strikingly differs, in the existence of post-orbital arches as in all existing ruminants; in the greater size of the orbits; in the presence of deep lachrymal depressions, relatively as large as those of the Deer or of the extinct *Bootherium;* and in other important particulars. The true molar teeth are decidedly of a ruminant character; while canines and incisors exist in both jaws, and form with the molars almost unbroken rows, as in *Anoplotherium.*

Lateral View.—(Pl. II. Figs. 1, 3; III. 2; V. 1; VI. 3, 4, 6.) The side view of

[1] Proc. Acad. Nat. Sci., V. p. 237.

the skull resembles in its general form very much that of *Anoplotherium*. The upper outline of the skull forms an almost unbroken convexity from the inion to the end of the nose; being depressed very slightly only upon the forehead at the bifurcation of the sagittal crest. The outline of the inion is obliquely downward and forward, and is only intruded upon by the occipital condyles.

Among existing ruminants, the cranium proper of *Oreodon* is very like that of the Camel and Llama. As in these, the temporal fossa is large and extends superiorly to the median line of the skull, where it rises upon a prominent sagittal crest, which posteriorly, in conjunction with the occiput, forms an eminence projecting above the inion and constituting its summit. The fossa at the margin of the inion forms an oblique crest, which relatively is not as deep as that of the Camel, and which is constituted by the junction of the squamous portion of the temporal bone with an elongated process from the pars petrosa intercalated between the former and the occiput; and above by the occiput alone. Anteriorly the fossa is bounded by the divergent portion of the sagittal crest upon the post-orbital process.

The temporal surface generally is smooth and convex, but is concave along the course of the occipital crest and the sagittal crest posteriorly, and as in the Camel, nearly one-half of its extent is constituted by the squamous portion of the temporal bone.

Following the course of the squamous suture at its anterior part, in some of the crania, the parietal bone is depressed into a groove, resembling the impression of a bloodvessel, or the trochlea of a tendon; but in other specimens this groove does not exist, or is very slight. At the back part of the same suture, varying in position in different individuals, are one or two vascular foramina, directed upward and backward. (V. 1.)

In all the specimens under investigation the zygomatic arch is broken; but, judging from a portion remaining in the skull of an immature animal, it is relatively as strong as in the Camel. (VI. 6.)

The malar bone, as in the Deer, has a much more anterior position than in the Camel, but it is more robust than in this, and its outer surface is convex and on the same plane with the entrance of the orbit, being directed forward and upward. Anteriorly, it is continuous with a corresponding swell of the face, converging forward above the alveolar processes.

The post-orbital process of the os frontis combines with that of the malar bone, so as to form a complete post-orbital arch, such as exists in all recent ruminants; which is relatively stronger than that of the Deer, Ox, or Sheep, but is not quite as strong as in the Camel. (IV. 3; VI. 4, 6.) The temporal attachment extends upon the post-orbital arch, as far as the transverse suture.

The entrance of the orbit is sub-rotund, and is directed to about the same extent forward as in the Deer, but in a slight degree more upward. (IV. 3.)

The face, in its general form, strongly resembles that of *Anoplotherium;* and in comparison with that of the Deer, not only appears to be shortened to an extent corresponding with the vast hiatus existing anterior to the molars in the latter, but also to recede; for, the last molar is on a line vertical to the post-orbital arch, as

in the Camel and *Anoplotherium;* whereas, in the Deer, and other ruminants, it is beneath the anterior part of the orbit. (II. 1, 2.)

Internal to the position of the malar bone, the face is deeper than in *Anoplotherium*, but relatively is not as deep as in the Camel.

The infra-orbitar foramen is placed above the position of the third premolar, and is more advanced than in the *Anoplotherium* or Camel, but is less so than in the Deer, Ox, Sheep, and other ruminants. The face, from the post-orbital arches to the nose, constitutes very nearly an equilateral triangle, being relatively broader between the post-orbital arches, or at the base of the triangle, than in *Anoplotherium*. The side of the face, in advance of the orbit, is vertically convex, and one of the most remarkable features of the genus exists upon this surface, viz., a large lachrymal depression gradually commencing at the borders of the bones in sutural connection with the lachrymal bone. This depression is rather more elevated in its position than in the Deer, and is hemispherical, as in the extinct genus of pliocene Oxen, the *Bootherium*. Anterior to the infra-orbitar foramen the face is slightly depressed, and just in advance of this position is a gentle rise, corresponding to the course of the fang of the canine tooth.

The lateral view of the extremity of the nose resembles more that of the *Anoplotherium* than of any existing ruminants, presenting the same slope lateral to the convex termination of its floor, which is constituted by the incisive alveoli. The intermaxillary bone, however, is very much smaller than in this genus, projecting as it does at the lateral margin of the nose only very slightly beyond the end of the maxillary, and at the incisive alveoli a very small distance relatively beyond the anterior line of the canine tooth. (II. 1.)

Superior View.—(Pl. IV. Fig. 1; V. 4; VI. 1.) The upper view of the cranium proper, much resembles that of the Camel. The sagittal crest is prominent, and pyramidal, with concave sides; and it bifurcates immediately at the position of the coronal suture. The forehead generally is convex; and it has very nearly the form of that of the Camel, but it is less prolonged outwardly towards the orbits, and is not so prominent above these, and also is relatively not quite so much depressed at the bifurcation of the sagittal crest.

The supra-orbitar foramen varies in its exact position in different individuals, but is usually situated a short distance from the frontal suture, and nearer to the fronto-nasal, than to the coronal suture. It is directed forward, and is continuous with a shallow groove passing to the outer side of the fronto-nasal suture. (IV. 1.)

The muzzle is relatively short, as in *Anoplotherium*, and superiorly is usually transversely convex, with the sides vertical; but in some specimens it is nearly flat at the nasal bones.

As far as can be ascertained in any of the specimens, but principally from an impression upon a portion of matrix, the anterior extremity of the nose, as constituted by the ends of the ossa nasi, appears to have been like that of the Deer; and the lateral margin and incisive alveoli are convex; and the latter project relatively to their position in *Anoplotherium*, or recent carnivora, very little beyond the front of the canines.

Posterior View.—(Pl. IV. Fig. 2.) The occipital surface resembles a good deal

that of *Anoplotherium*. Its median portion bulges backward above the foramen magnum, and is concave below the summit of the inion. The lateral portions of the surface are directed outwardly from the median, and are moderately concave, but relatively much less than in the Camel.

The lateral margin of the inion, or the occipital crest, is relatively less prominent than in the Camel; and at its lower part is formed, as in the Deer and other ruminants, by the elevated border of the pars squamosa and a process of the pars petrosa intercalated between the former and the occiput.

The occipital foramen is transversely oval and emarginate above.

The condyles resemble those of the *Anoplotherium*, and do not advance upon the basilar process inferiorly as in the Camel, Deer, and other ruminants. Their position corresponds pretty closely with that which they have in the Camel; and their angle and superior and inferior faces present in the same direction.

Inferior View.—(Pl. III. Fig. 1; V. 2, 3; VI. 3.) The base view of the skull, in its general form, much resembles that of *Anoplotherium;* but it is relatively broader in comparison with its length, and presents numerous peculiarities. The basilar process slopes on each side from a central crest, which expands at the condyles and at its junction with the post-sphenoidal body. The surface of the latter is smooth, slightly convex, and inclines slightly upward in its direction forward. (III. 1; V. 2.)

The pterygoid processes commence a little in advance, and to the outside, of the position of the spheno-basilar junction, and are very oblique in their course downward and forward. To their inner side is a shallow groove, directed to the foramen lacerum, for the reception of the Eustachian tube.

The paramastoid processes form the infero-lateral terminations of the occiput, and are conspicuous objects either in the lateral or posterior view of the skull. They are relatively about as long and strong as those of *Anoplotherium*, but are nearly vertical, or bent slightly forward and outward. Their form is elongated pyramidal, and the outer portion of their base abuts upon the posterior process of the pars petrosa, as in the Deer; while the antero-internal portion rests upon the auditory bulla. Antero-externally the para-mastoid process is longitudinally excavated, and between its base and the pars petrosa it incloses the stylo-mastoid foramen, and in advance of this the pit of reception for the styloid process. (III. 1; V. 2.)

The mastoid process is small, as in all ruminants, and is a compressed eminence or ridge forming the posterior boundary of the meatus auditorius externus. It does not descend as low as the bottom of this, and projects between the auditory process from which it is separated by a notch, and the base of the paramastoid process.

The auditory process constitutes the antero-inferior boundary of the meatus, and inferiorly forms a ridge-like vaginal process curving forward and inward to the auditory bulla with which it is continuous.

The latter is relatively very small to what it usually is in ruminants, and corresponds in this respect with *Anoplotherium*. It is convex, surmounted by the ridge just indicated, rests against the paramastoid process posteriorly, and is continuous with the bony process of the Eustachian tube anteriorly. Internally, as in existing

ruminants, the pars petrosa borders a large irregular excavation, constituting the foramen lacerum posterius, and anterius, and a portion of the Eustachian tube.

Immediately posterior to the foramen lacerum, and internal to the base of the paramastoid process, the hypoglossal or anterior condyloid foramen is situated.

The foramen ovale holds the same relative position as in recent ruminants, being a little to the outside of the commencement of the pterygoid processes, and in advance of the bony process of the Eustachian tube.

The glenoid articulation, one of the most important features of the cranium in reference to the habits of the animal, is broad as in existing ruminants, is slightly convex anteriorly and concave posteriorly; and in this position is bounded by a mammillary post-glenoid tubercle, which is compressed antero-posteriorly, and is relatively very large and robust. This tubercle is a very conspicuous object in the lateral view of the head, and projects below the auditory process and bulla. Between it and the auditory process is a narrow fissure, and at the bottom of this internally is the glenoid foramen.

Antero-internally, the glenoid articulation is prolonged upon a broad surface for muscular origin, formed by the conjunction of the post-sphenoid and pars squamosa, and terminating anteriorly in a pyramidal eminence, as in the Deer.

The pterygo-palatine notch is long and narrow, and extends as far forward as the posterior third of the last molar. Its margins are thick, strong, and rounded.

The notch extending between the palate bone and the tuber maxillare is almost as deep as that of the Deer, but is more angular. It terminates on the same line nearly as the pterygo-palatine notch, as in the Sheep.

The hard palate is slightly arched, and deepens in an angular manner towards the centre. In some of the specimens it deepens very much, and in others not more than in the Deer in advance of the molars. Its lateral margins, corresponding with the alveoli, are nearly parallel throughout the course of the molar series.

The posterior palatine foramina are pierced in the palate plates of the superior maxillary bones on a line with the fourth or third premolars.

The position of the incisive foramina, as far as can be ascertained from the imperfect specimens, appears to be on a line with the canine teeth.

Orbits.—(Pl. IV. Fig. 3; VI. 4, 6.) As before observed, the entrance of the orbit is subrotund and directed outward, and a little forward and upward. Its margin is less prominent than in the Deer, and at the inner canthus is elevated into a vertical, slightly sigmoid, compressed mammillary, lachrymal process. The inner wall of the orbit is more oblique in its course backward to the optic foramen than in the Deer, and the alveoli contribute more to its floor, which is deep and concave.

The entrance to the infra-orbital canal is a broad oval orifice at the lower part of the front of the orbit, formed below by the alveolar processes and above by the lachrymal and palate bones.

The lachrymal foramen is vertically oval, and contracted at its lower part, and is situated just within the lower part of the lachrymal process. Near it externally is a small round foramen.

At the inner side of the entrance of the infra-orbital canal, are two foramina, homologous with the posterior palatine and spheno-palatine foramina.

Another foramen, the anterior orbital, is situated in the suture between the lachrymal and palate bone, about half way between the entrance to the infra-orbital canal, and the lachrymal margin of the orbit.

The foramina spheno-orbitale and rotundum, form one large and vertically oval foramen, which is situated just within the pyramidal process forming the terminal conjunction of the temporal and pterygoid surfaces.

The optic foramen is situated some distance in advance of, and slightly above the position of the spheno-orbital, is about one-third the size of the latter, and is also vertically oval.

The bones which contribute to the construction of the orbit are the lachrymal, frontal, superior maxillary, malar, palatal, and anterior sphenoid.

Form, Relations, and Connections of the Bones of the Skull.—The occipital bone posteriorly, is trilateral with a prominent apex, and it terminates by its other angles in the long paramastoid processes.

The lambdoidal suture commences at the outer side of the base of the latter, and ascends posteriorly between the occiput and the process from the pars petrosa, and then advances over the occipital crest to the side of the cranium between the occipital and parietal bones. It is serrated, and at the occipital summit it forms a trifoliate line.

The spheno-basilar connection is not obliterated in the adult specimens under investigation, but is elevated and distinct.

As in the Camel, the squamous portion of the temporal bone, from its great relative size to that of most other animals, is a striking feature in the anatomy of the temporal fossa.

The squamous suture forms about three-fifths of an oval outline, and is pretty strongly serrated as in ruminants generally.

Between the pars squamosa and the occiput posteriorly, is a narrow process from the pars petrosa, ascending from between the mastoid process and the base of the paramastoid, to the conjunction of the occipital with the parietal bones. To the pars squamosa and occiput, it is connected by serrated suture.

As in all ruminants, there is only a single parietal bone; and, as in the Camel, this is remarkable for its length in comparison with that of more ordinary members of the family. It is narrowest posteriorly, and gradually widens to the anterior portion of the squamous suture, where it descends to the wings of the post-sphenoidal bone. Anteriorly it is deeply notched for the reception of the posterior part of the ossa frontis.

The body of the post-sphenoidal unites with that of the ante-sphenoidal on a line with the spheno-orbital foramina.

The wing of the ante-sphenoidal bone articulates with the vertical plate of the palate bone, the frontal, a small portion of the parietal, and the wing of the post-sphenoidal bone.

The external pterygoid process is united with the internal, as in the Sheep and

other ruminants; but it is very much more oblique in its course than is usual in these, and even more than in the Sheep.

The internal pterygoid process shows itself as in recent ruminants, at the posterior extremity of the orbit, between the vertical plate of the palate bone, the external pterygoid process, and the wing of the post-sphenoidal bone.

The frontals remain separated in the adult condition, and are relatively shorter than those of ordinary ruminants. They commence in an angular manner posteriorly, and expand rapidly forward and outward to the post-orbital margin, as in the Camel, and then converge forward, the supra-orbital margins being nearly straight, and terminate in angular processes which advance beyond the ossa lacrymalia. Anteriorly they form a deep notch, extending nearly to a line with the anterior orbital margin, for the reception of the posterior extremities of the ossa nasi.

The forehead, as constituted by the ossa frontis, ordinarily is prominent and convex above the orbits, and slightly depressed along the median line or course of the frontal suture. The orbit presents more upward than in recent ruminants, and the post-orbital process in its descent to join the malar bone is directed more outward; and it also is directed backward, as in the Camel, though not to the same relative extent. The nasal bones, anterior to the angular processes of the ossa frontis, are of nearly uniform breadth, are slightly convex, and incline more or less outwardly.

The lachrymal bone forms two sides of an irregular cuboidal figure, with the facial side depressed into a deep hemispherical lachrymal sinus. The two sides are sub-equal, and their angle of union constitutes the anterior orbital margin. Inferiorly the orbital side forms the supero-external boundary of the entrance to the infra-orbital canal; and postero-internally it is deeply notched for the reception of the upper extremity of the palate bone.

As in recent ruminants, the lachrymal bone articulates with the os frontis, os maxillare, os malæ, and os palati; and it is separated some distance from the os nasi by the advance of the angular process of the os frontis.

The palate plates of the ossa palati advance as far as the position of the first true molar, and in some specimens, to the interval between the latter and the fourth premolar. The vertical plates are shallow, but relatively broader than those of recent ruminants.

In the orbit, the palate bone forms the internal boundary of the entrance to the infra-orbital canal, and is pierced internal to this by the posterior palatine canal, and the homologue of the spheno-palatine foramen. It articulates with the maxillary, the frontal wing of the anterior sphenoid, the anterior margin of the internal pterygoid process, and the extremity of the external pterygoid process.

The superior maxillary bone, compared with that of recent ruminants, is not as short as might be supposed; for the space in these which constitutes the hiatus anterior to the molar series, is in *Oreodon* occupied by a molar additional to the ordinary functional number, together with a well-developed canine; leaving a little vacancy for the accommodation of an inferior canine. Its outer side is vertically convex, but is depressed in advance of the infra-orbital foramen.

The suture between the maxillary, and malar and lachrymal bones, ascends in

an irregular oblique line from the antero-inferior angle of the malar bone, opposite the position of the second true molar, to the angular process of the os frontis at some distance posterior to its termination.

The malar bone below the orbit externally, presents a single, smooth, convex surface, slightly directed upward. Its inferior margin is thick, strong, and roughened; and its posterior extremity beneath the position of the post-orbital arch, is deeply notched for the reception of the anterior extremity of the zygomatic process of the temporal bone.

The intermaxillary bone, compared with that of recent ruminants, or of the *Anoplotherium*, or even with that of carnivora, is very small but strong. Its upper extremity is received into a notch of the maxillary bone, and does not come into contact with the nasal bone.

Inferior Maxilla.—(Pl. II. Figs. 1, 3; IV. 4; VI. 4, 6.) The lower jaw is intermediate in its form to that of the extinct *Anoplotherium* and the common Hog, except that the alveolar margin, at its anterior extremity, is not everted as in the latter, but retains the upward direction, as along the course of the molar alveoli.

The body of the bone, compared with that of the Deer, is relatively deep, and its base pursues a less sigmoid course, and is very like that of *Anoplotherium* Its outer side is vertical, and very slightly convex, but anterior to the mental foramen is convex forward, or rapidly convergent to the symphysis. Its thickest part is along the line of the latter, and that of the alveoli.

The symphysis is deep, and forms a strong slope; but it approaches the vertical line much more than in the *Anoplotherium*, or than in the Hog. Its lower part, or the posterior mental tubercle, is on a line perpendicular to the second premolar, or in some specimens to the interval between this and the third.

The alveolar margin ascends so rapidly posterior to the last premolar, that the body of the lower jaw behind the last molar, is deeper by more than half than it is below the former tooth.

The ramus is relatively as broad as in the Hog, but is more vertical and convex upon its outer face. It is relatively deeper than in *Anoplotherium*, but is less produced backwards than in this, and more so than in the Hog. The posterior margin is thick and convex, and projects externally into an irregular ridge for the masseteric attachment. The inner side of the ramus inferiorly presents a concavity which converges forward below the molar alveoli. Below the notch separating the condyle and coronoid process the external surface presents a depression in form like that of the Peccary, but deeper, in the possession of which *Oreodon* differs from all recent ruminants.

The coronoid process, in comparison with that of the latter, is remarkable on account of its shortness, being relatively not longer than that of the Hog, which it also resembles in form and relation to the condyle. The latter is a transverse convexity, very slightly inclining downward within, and possesses about the same extent and form as in the Peccary.

The anterior mental foramen is placed below the second premolar, or the interval between it and the first. Not unfrequently there is a second, or even a third, but smaller foramen, situated at variable distances posterior to the principal one.

Dentition.—The dentition of *Oreodon* is remarkably distinct from that of any living or any known extinct genus, and it indicates the combined habits of ruminating and suilline animals, or, in other words, it appears to characterize a ruminating hog.

The formula of the permanent dentition is as follows:—

$$i.\ \frac{3\ 3}{4\ 4}\ c.\ \frac{1\ 1}{1\ 1}\ p.m.\ \frac{4\ 4}{3\ 3}\ m.\ \frac{3\ 3}{3\ 3} = 44.$$

The true molars are constructed after the type of those of recent ruminants; the premolars approach most, among recent animals, those of the deer tribe; the canines, those of the peccaries; and the incisors occupying both jaws, in this relation among living ruminants, find their nearest representative in the camel tribe.

Relative Position of the Teeth.—(Pl. II.—VI.) The upper molars, internally, are nearly parallel upon the two sides of the jaw, but externally they are convergent forward from the second true molar, by reason of the gradual decrease in size of the teeth in advance of this. Viewed laterally, they present a convexity downward rather greater than that in the Deer.

Each true molar, at its antero-external margin, projects exterior to, and a little in advance of the contiguous margin of the preceding tooth, as among existing ruminants, in *Anoplotherium*, *Rhinoceros*, etc.

The fourth premolar, and in some specimens the third, project at their antero-external margin exterior to the outer face of those preceding, but never in advance of this point.

The second premolar, on the contrary, has its anterior margin a little within the position of the first, as if this had been pushed backward and outward to form the small hiatus existing between it and the canine.

The face increases slightly in breadth in advance of the premolars; apparently for the accommodation of the canines, which, at the base of their crowns, project one-third their transverse diameter exterior to the first premolar.

The hiatus existing between the upper first premolar and the canine, is only sufficiently large to receive the point of the inferior canine. Between the upper canine and the incisors there is usually, but not in all the specimens, a hiatus smaller than the former, adapted to the accommodation of the outer angle of the crown of the large lateral incisor below.

The superior incisors are arranged in the arc of a circle greater than in the Wolf, and they project vertically downward, and very little in advance of the position of the canines.

The inferior molars of the two sides are internally nearly parallel; and are much more nearly so externally than the upper molars, from the breadth of these being less uniform. Viewed laterally, the triturating surface of the former presents a concavity corresponding to the convexity of the series above.

The relation of the true molars and of the third premolar to one another, is the same as in existing ruminants. The anterior margin of the second premolar is placed within the position of the first, and the corresponding portion of the latter holds the same relation to the canine; apparently as if these teeth had been pushed outward and backward in a jaw, in which little space could be spared to form, ante-

rior to the lower canine, a hiatus of sufficient size to accommodate the cusp of the upper one. This hiatus is in a trifling degree less than that posterior to the upper canine.

The inferior incisors are oblique in their position, but relatively, less so even than in the Musks; and they form a longer arc of a lesser circle than those of the upper jaw.

When the jaws are closed, the inferior molars are situated within the line of the outer lobes of the upper true molars, but anteriorly they are placed very little within the outer faces of the upper premolars.

The intervals between the pyramidal crowns of the premolars are triangular, and the three inferior crowns are included by the four superior ones.

The crown of the superior canine is directed downward and outward, and, as in the genus *Pulæotherium*, it is placed in advance of the canine below; a position which is exceedingly anomalous. Its point projects considerably exterior to the inferior canine, and only its internal angular margin occupies the hiatus in advance of the latter tooth.

The crown of the lower canine is directed upward, and a little forward and outward; and its point, though projecting slightly exterior to the hiatus provided for it above, is yet within the line of the outer surface of the upper canine.

The inferior incisors, laterally, are included within the circle of the superior; while the cutting edges of those anterior come in contact with the edges of the corresponding teeth above. The outer sides of the upper incisors are vertical, and those of the lower incisors incline to them at an angle of about 50°.

Superior Molars.—(Pl. II. Figs. 1, 3; III. 1, 2; IV. 6; V. 2, 3; VI. 2, 3, 4, 6.) The crowns of the upper true molars are composed of four symmetrical lobes, as in all existing ruminants. Among these, they approach most in their form the crowns of the corresponding teeth of the Deer, but they are more expanded transversely, and more square, the interlobular depressions more shallow, and the inner lobes are uncomplicated with accessory folds or lobes. Among the extinct ruminants of which we have any knowledge, they resemble most those of *Merycopotamus;* but they differ from the teeth of this genus in a number of particulars, more especially in the non-isolation of the outer lobes (which conjoin in a prominent buttress, as in *Anthracotherium*), and in the relatively slight degree of development of the basal ridge, which does not traverse the bottom of the transverse interlobular space, as it does in the *Merycopotamus*. From the corresponding teeth of *Anthracotherium*, *Hyopotamus*, and *Cænotherium*, they differ most in the absence of the fifth constituent lobe, which in the former two genera is introduced between the anterior pair of normal lobes, and in the last genus between the posterior pair. From those of *Dichodon*, they differ in the absence of the curiously cuspidate basal ridge, and in the less acuteness of the lobes. Finally, from the true molars of the most aberrant forms of extinct ruminants, the *Anoplotherium* and *Chalicotherium*, they differ as characteristically as do those of any of the existing members of the family.

When unworn, the lobes of the true molars have acute crescentic summits elevated to a middle point. The outer lobes anteriorly, and consequently

where they conjoin in each tooth, form prominent columns, not robust and convex, as in *Hyopotamus*, but antero-posteriorly compressed and rather abruptly expanded near the base of the crown, where they are more or less connected by intervening portions of a basal ridge. In some specimens, however, this ridge is obsolete, more especially at the postero-external lobe. (II. 1, 3; III. 1, 2.)

In two specimens under investigation, the basal ridge externally is well developed, strong, and rough at the margin; and it exhibits a tendency to extend itself on the outside of the projecting columns, as is indicated by a roughness of the enamel. (III. 1, 2.)

As in all ruminants, there is a disposition in the postero-external lobe of the molars to form a posterior column or fold, which, however, to a great extent, except in the case of the last molar, remains aborted; and which, in the external view of the jaw, is concealed by the anterior column of the antero-external lobe.

The outer faces of the external lobes of the molars between the columns are transversely concave, slightly prominent in the median line; and they incline at an angle of about 40°. The inner faces are nearly vertical, but they incline slightly outward, and are angularly convex.

The internal lobes appear broader transversely than the external, because their outer face becomes confluent at the basal third of the inner face of the latter.

The outer face of the internal lobes is concave, and very slightly prominent in the median line; and it inclines to about the same extent as the corresponding surface of the external lobes. The inner faces are not quite as angular in their convexity as those of the external lobes.

The summits of the latter are confluent at the apex of the median outer column, but those of the internal lobes are not confluent. The anterior extremity of the summit of the postero-internal lobe ceases abruptly, and it is included between the anterior half of the inner face of the postero-external lobe, and the posterior extremity of the summit of the antero-internal lobe, which latter extremity bends forward to the posterior part of the inner face of the antero-external lobe, and then terminates abruptly.

Portions of a basal ridge, which are sometimes more or less excavated, and have an irregular crenulated margin, usually exist at the bases, anteriorly and posteriorly, of the internal lobes. Occasionally they are continuous around the base of the postero-internal lobe of the second and third true molars, but more frequently upon the latter alone than upon both. Between the lobes internally, the ridge sometimes forms a single tubercle, simple and obtuse, or excavated.

In the trituration to which the true molars are subjected in mastication, the summits of the anterior lobes suffer at first more than those of the posterior, and the internal more than the external; but, in course of time, the abrasion is nearly equalized over the grinding surface.

When the dentinal substance is first exposed by the removal of the enamel summits of the external lobes, the surface presents the form of the letter **W**, or of two crescents, confluent where contiguous. At the same period, the inner lobes present distinct broader crescents of exposed dentinal substance. As the attrition proceeds, the latter crescents increase in breadth, and also become continuous.

Subsequently, small portions of the external faces of the inner lobes, in continuity with greater portions of the internal faces of the outer lobes, are left upon each tooth, in the form of two crescentic islets of enamel, occupying the middle of broad spaces of dentine. The portions of the external faces are first obliterated, but they are speedily followed by the remaining portions of the other faces; and the teeth then present only broad, quadrate, dentinal surfaces, bordered by enamel, and bilobed internally and externally. (VI. 2.)

All the premolars have a general resemblance to those of *Anoplotherium*, but they differ in many details of structure. The fourth premolar is composed of a single pair of symmetrical lobes, as are the functional three premolars of all existing ordinary ruminants, and the corresponding tooth of the Camel. The lobes of the fourth premolar are the equivalents of one of the transverse pairs of the true molars, except that they are considerably larger, and that the column at the antero-external margin is not as prominent. (II. 1, 3; III. 1, 2.)

The anterior three premolars decrease a little in succession forward, and the crown of each forms an irregular trilateral pyramid with a pointed apex. The third premolar is broader posteriorly than anteriorly; and, in transverse section, it forms nearly an equilateral triangle. The others are of more uniform breadth transversely, and in section have a more elliptical outline.

In all the premolars, the outer face is cordiform; and in the last of them, it is concave transversely; in the third it is less so; and in the remaining two it is convex, in consequence of the gradually increasing breadth of the median prominence common to these and the true molars.

The inner side of the crown of the third premolar presents a lobe which is like the internal lobes of the true molars; but it is aborted, and it occupies a position exactly corresponding with that of the posterior half of the inner face of the external lobes of the true molars. In advance of this aborted lobe, the anterior half of the inner face of the tooth presents a double enamel fold, inclosing a pair of *culs-de-sac*.

The inner portions of the two anterior premolars present the same elements of structure as the third, but in a more rudimentary condition; in the first premolar, the postero-internal lobe, as it exists in the two premolars behind it, being almost entirely obsolete.

From mastication, the grinding surface of the fourth premolar passes through the same phases as the corresponding portion of a true molar. Among our specimens of the other premolars, there are none which exhibit the course of attrition; but there are several which indicate that, at first, the wearing is greatest at the postero-internal side.

Inferior Molars.—(Pl. II. Figs. 1, 3; III. 3–6; IV. 4; VI. 4–11.) As in all existing ruminants, the lower true molars of *Oreodon* have two pairs of symmetrical lobes; and the last of the series has an additional lobe.

In their form they bear a very great resemblance to those of the Deer, but they are relatively more expanded in breadth, and the transverse pairs of lobes are less oblique relatively to each other. Other and important differences are briefly as follows :—

The inner lobes internally are less prominent in the middle line; their posterior marginal fold is less developed, is shorter, and more divergent; and their external face is more convex. (III. 4.)

The outer lobes are less angular externally, and are more tapering from their base.

Finally, the tubercle between the bottom of the outer lobes is not conoidal, but it appears as a transverse talon with an external angular notch.

The posterior lobe of the last true molar is relatively larger than in the Deer, and is more elliptical in transverse section. (III. 5, 6.)

In the attrition to which the inferior true molars are subjected in mastication, crescentic surfaces of dentinal substance are exposed by the removal of the originally acute enamel summits of the lobes. As the wearing progresses, the dentinal crescents increase in breadth; most rapidly upon the outer lobes until the abrasion reaches the bottom of the inner faces of these; at which period the outer dentinal crescents are considerably below the inner ones, and are twice as broad. At the next stage, a small portion of the internal face of the outer lobes, in union with a larger portion of the external face of the inner lobes, is left between each transverse pair of lobes as a crescentic islet of enamel upon a broad surface of dentine. The external portion of the islet is next obliterated, and is soon followed by the remainder or internal portion. At a late period, the upper surface of the external portions of the basal ridge is worn away by the apices of the outer lobes of the superior molars, so as to leave shallow pits in the dentine. (VI. 5, 8.)

The inferior premolars exhibit more peculiarity in comparison with the true molars, than do the anterior three upper premolars. (II. 1, 3; III. 3, 4; VI. 4, 5, 8, 9.)

In the Deer, it is easy to trace in the lower premolars, the constituent lobes of the true molars. Thus, in the third premolar the anterior pair of lobes are very like the corresponding pair in the true molars, but the posterior pair have undergone modification in size, form, and position. In the second premolar, the antero-internal lobe of the true molars appears to be represented by the anterior double fold, their corresponding outer lobe by the succeeding largest fold, and their posterior pair of lobes by the two hinder folds. In the first premolar, all of the four lobes may be traced as in the second premolar; but all, save the homologue of the antero-external lobe, are reduced to their most rudimentary condition, and in some individuals are entirely obsolete.

The plurality of lobes of the true molars is much less readily distinguishable in the premolars of *Oreodon* than in those of the Deer; nevertheless, their gradual disappearance may be traced.

The premolars decrease in size from the last to the first, and each presents an antero-posteriorly broad pyramidal crown. The transverse section of the crowns of the posterior two at their base is an isosceles triangle with the apex directed forward; while the section of the crown of the anterior at the same position is elliptical.

Externally they are all prominent at the middle and are convex transversely, and the posterior half of the surface is directed outward; while the anterior portion presents forward and outward. The first premolar is simply convex externally; the second presents a slight fold at the posterior part of the external surface; and the third is depressed posterior to the median prominence of the same surface. Postero-

internally the last premolar is excavated into a quadrilateral cul-de-sac, of which the inner boundary is a pyramidal tubercle, the homologue of the postero-internal lobe of a true molar. The outer apex of the tooth continues inward upon the summit of a pyramidal sub-lobe, apparently homologous with the antero-internal lobe of a true molar. In advance of this sub-lobe, there is a broad notch sloping to the base of the tooth.

The second premolar exhibits internally a rudimentary form of the corresponding portion of the tooth behind. The tubercle has disappeared; and the sub-lobe in advance of this has degenerated into an oblique ridge descending obliquely backward from the summit of the tooth. The surface postero-internal to this ridge is sloping, and receives from it a slight abrupt offset. Anterior to the ridge, the internal surface presents a simple, broad, sloping depression.

The first premolar exhibits internally a simple ridge descending from the summit obliquely backward, and dividing the surface into two depressions, of which the anterior is the broader.

In tracing upon the premolars, among our specimens, the effects of mastication, it is observed that when the enamel is nearly obliterated from the triturating surfaces of the true molars, the bottom of the posterior cul-de-sac in the third premolar is left as a small oval islet of enamel upon a broad shoe-formed surface of dentine; while the second premolar is worn so as to present a surface of dentine having the form of a Greek ε. (VI. 8.)

As in existing ruminants, the inferior molar teeth of *Oreodon* are inserted by two fangs placed one before the other. The last molar having a fifth lobe, the posterior fang is proportionably broad, and is constituted by a confluent pair.

Canines.—(Pl. II. Figs. 1, 3; III. 1, 2.) The possession of well developed canine teeth in both jaws, is one of the most remarkable characteristics of *Oreodon*. The form of these teeth is peculiar; neither those above nor below grow from persistent pulps; and only the crowns are capped with enamel. Those which I have concluded to belong to the male of *Oreodon*, are more robust than those attributed to the female.

The upper canine, commencing at the extremity of its fang above the interval of the first two premolars, curves forward, downward, and in a less degree outward. In the male, it is directed more externally than in the female. The fang of the upper canine renders the face slightly prominent along its course, and is trihedral, with rounded margins, and approaches more or less a cylindroid form. In some specimens it is flattened, or nearly so, upon the outer side, and exhibits one or two slight flutings at the lower part.

The crown is a trihedral pyramid, with the lateral margins acute, the anterior margin subacute, and the summit pointed. Its sides are nearly equal; one being directed outwardly, another inwardly and forward, and the third posteriorly. The first is nearly plane; and the second is also nearly plane, and presents a median obtuse ridge, which vanishes above in the fang, and below towards the point of the crown. The remaining side is visible in only one specimen; its enamel is worn off, excepting a small portion at each basal angle; and it is quite plane and smooth, and is a little larger than the other sides.

The point and lateral margins of the crown of the upper canine were kept constantly sharp, by being subjected to attrition only at the posterior part, where it came in contact with the corresponding tooth of the lower jaw.

The inferior canine is straight, and is directed from the end of its fang obliquely upward, forward, and outward.

The fang is variable in its form in different specimens; in one its section is transversely compressed and elliptical, in another cylindroidal, and in a third quadrilateral with rounded margins.

The crown is a broad, transversely-compressed pyramid, with trenchant margins converging to a slightly rounded but sharp summit. It is of about the same length as that of the upper canine, but is a little broader.

The inner face is convex; and the outer face is angularly convex, with one portion directed outwardly, and the other antero-externally.

The anterior margin is directed inward and forward, and at its outer part, when the jaws are closed, comes into contact with the posterior face of the upper canine, so as to suffer from attrition most in this position. The margins at the bottom of the crown project slightly beyond the outline of the fang.

The enamel of the canines is a little thicker externally than internally, and is slightly corrugated; and that upon the trenchant margins of the lower ones has a slightly crenulated appearance.

Incisors.—(Pl. II. Figs. 1, 2.) In only one specimen among the many under investigation are the incisors preserved, and in this, their outer face alone is visible, the other being enveloped in a matrix, the removal of which would endanger their integrity. There are three incisors above, and four below, upon each side of the median line.

Of the superior incisors, the internal is smaller than the outer two, which are nearly equal in size. Their outer face is convex, and they are trapezoidal or nearly ovoid in outline, with the long diameter about one-fourth greater than the transverse. The cutting edge and inner margin are convex, and the outer margin has a slightly prominent talon.

Of the inferior incisors, the internal is the smallest; the succeeding two are nearly equal in size, and the external is a fifth larger than the others. The outer face of the anterior three incisors is convex, and oblong quadrilateral. The cutting edge of the first incisor is convex, that of the second slightly so, and that of the third straight. The lateral margins have a more prominent talon than those of the incisors above, and this is larger externally, and is situated about half-way down the crown. The outer face of the external or fourth incisor is also convex, but is more trapezoidal than the others. Its cutting edge is convex, and is above the level of those of the incisors in advance of it. The lateral margins are oblique and nearly straight.

The presence of eight incisors, in addition to well-developed and undoubted canines, in the lower jaw of *Oreodon*, appears to indicate, in accordance with the view of M. Cuvier, that the lateral or fourth incisors of existing ruminants, are true physiological incisors; and not transformed canines, as inferred by Mr. Owen, unless

we adopt a hypothesis which supposes the lateral incisors of *Oreodon* to be transformed canines, and the functional canines to be the transformed first of the normal series of seven molars. The latter view is favored by the absence in *Oreodon* of the first of the normal number of molars, and also by the unusual position of the inferior canine tooth. Further, the latter has almost the exact form which would be produced by merely prolonging the crown of the first functional premolar. On the other hand, in *Palæotherium*, the lower and upper canines have the same relative position as in *Oreodon*, and yet the lower jaw has the normal number of premolars.

Temporary Dentition and Order of Succession.—The deciduous dentition of *Oreodon*, so far as can be ascertained from the specimens under investigation, is expressed by the following formula:—

$$i.\ \frac{?}{?}\ c.\ \frac{1\ 1}{1\ 1}\ p.m.\ \frac{2\ 2}{2\ 2}\ m.\ \frac{1\ 1}{1\ 1}.$$

In the order of protrusion of the temporary molars, judging from the relative extent of abrasion which these teeth have undergone in the specimens under observation, the true molar is first, and then follow the premolars in succession from behind forward.

Form of the Temporary Molars.—(Pl. IV. Figs. 4, 5; V. 2, 3; VI. 6, 7, 10, 11.) The superior temporary true molar has exactly the same form as the permanent true molars, but is about one-sixth less in size than the first of these. (V. 2, 3.)

The crown of the second upper premolar is composed of three lobes like those of the true molars: two posterior and transverse, the other anterior and opposite to them. It resembles very much the crown of the fourth permanent premolar in conjunction with that of a small third premolar. The anterior lobe at its inner side is connected with the adjacent side of the postero-internal lobe by means of a shallow fold, which forms a *cul-de-sac* between the two.

The anterior premolar has nearly the same form as the corresponding permanent tooth, but is smaller in size. Its antero-internal *culs-de-sac* are not as deep as in the latter, and the external of these is twice as broad as the other, but is shallower.

The inferior deciduous true molar, as in all existing ruminants, possesses three pairs of symmetrical lobes, which have the same form, and the same relative position with one another as those of the permanent true molars, but which decrease in size from behind forward. (IV. 4, 5; VI. 6, 7, 10, 11.)

The two deciduous premolars of the lower jaw closely resemble in form the corresponding permanent teeth.

The normal first superior molar appears to belong to the permanent series, succeeds all the temporary molars in the order of protrusion, and has no deciduous predecessor.

The permanent true molars successively protrude and occupy their functional position before any of the deciduous molars are shed. The displacement of the latter by their permanent successors, appears to begin with the eruption of the last of these, which is followed by those in advance. The first permanent premolar of the upper jaw appears to have protruded after the deciduous teeth,

and occupied a position with them in the functional series, but remains after these are shed.

In comparing Prof. Owen's figure of the series of upper molar teeth of *Hyopotamus vectianus* (in Plate VII. Vol. IV., of the London Quarterly Journal of the Geological Society), with that stage of the dentition of *Oreodon* in which the permanent true molars occupy their functional position in company with the deciduous teeth, I cannot avoid a suspicion that what are represented as the third and fourth permanent premolars (the latter of which has the exact form of the succeeding permanent true molars), are really deciduous teeth, which were to give place to more simple, bilobed, anthracotheroid, permanent premolars. The teeth, however, represented as of the latter character, to belong to the deciduous series, appear too slightly worn in relation to the condition presented by the first permanent true molar, although it is not improbable that the permanent true molars might follow the eruption of the deciduous teeth so rapidly as to exhibit little difference in the relative extent of their abrasion. In the lower jaw of an undoubtedly adult individual of another species, *Hyopotamus bovinus* (represented in Fig. 3 of Plate VIII. of the same work), it is observable that the anterior two permanent true molars are deeply worn, while the two permanent premolars in advance are but slightly abraded, which could not be the case under such circumstances as those presented by the upper teeth in the figure first referred to.

Oreodon Culbertsonii.

(Pl. II.; III.; IV. Figs. 1–5; V. Figs. 1, 2; VI. Figs. 8–11.)

Merycoidodon Culbertsonii, Leidy: Proc. Acad. Nat. Sci., 1848, iv., 47, pl. figs. 1–5.
Oreodon priscus, Leidy: Proc. Acad. Nat. Sci., 1851, v., 238.
Cotylops speciosa, Leidy: Proc. Acad. Nat. Sci., 1851, v. 239.
Oreodon Culbertsonii, Leidy: Owen's Report of a Geol. Survey of Wisc., etc., 548.

Of this species of *Oreodon*, I have had the opportunity of examining the following specimens:—

1. A very much fractured skull, with the posterior extremity, zygomata, post-orbital arches, upper margins of the orbits, upper part and left side of the end of the nose, and most of the teeth of the left side broken away.

On the right side, the entire series of teeth exist in both jaws in a state almost as perfect as when the animal was living. (Plate II. Fig. 1.)

From the collection of Mr. T. A. Culbertson.

MEASUREMENTS.[1]

	Inches.	Lines.
Height of face from infra-orbitar foramen to the end of the angular process of the os frontis	1	4
Distance of supra-orbitar foramina from the ossa nasi		7
Height of symphysis of lower jaw	1	8

[1] As far as the specimens permit, measurements are given to show the variations which may in this way exist in different individuals.

	Inches.	Lines.
Depth below the hinder portion of the lower middle premolar		11
Length of entire series of upper teeth	4	3
Length of entire series of lower teeth	4	4
Length of series of upper molar teeth	3	4
Length of series of lower molar teeth	3	3
Length of series of upper true molar teeth	1	10
Length of series of lower true molar teeth	2	
Antero-posterior diameter of last upper molar		9
Antero-posterior diameter of last lower molar		11
Length of crown of the canine teeth		7
Extent of hiatus behind the upper canine		3
Extent of hiatus between canines and incisors		1½

2. A very much mutilated skull, with the zygomata, upper superficial portion of the face, orbital margins, and rami and greater portion of the base of the lower jaw broken away. The specimen is very much fissured, apparently from exposure to the weather since its exhumation. All the teeth, except the crowns of the canines and incisors, remain on both sides.

The form, proportions, and size of the specimen correspond pretty closely with that first indicated.

From Messrs. Culbertson's collection.

MEASUREMENTS.

	Inches.	Lines.
Length of head from occipital condyles to the anterior incisive alveoli	7	5
Breadth of face at infra-orbitar foramina	1	8½
Breadth of face above first premolar	1	7½
Breadth of face at roots of incisors just in advance of the upper canines	1	2½
Height of symphysis of lower jaw	1	7
Depth of lower jaw below second premolar	1	½
Length of series of upper molars	3	5
Length of series of lower molars	3	3
Length of series of upper true molars	1	9½
Length of series of lower true molars	1	11

3. A much broken anterior portion of a skull, agreeing very closely in its form and proportions with the corresponding part of the preceding specimens.

From Capt. Van. Vliet's collection.

MEASUREMENTS.

	Inches.	Lines.
Breadth of face at infra-orbitar foramina	1	9
Distance from the latter to the frontal angular processes	1	4½
Length of series of upper molars	3	5
Length of series of lower molars	3	4
Length of series of upper true molars	1	9
Length of series of lower true molars	2	

4. An anterior portion of a skull containing all the true molars and one last premolar, with fragments of the others. It is accompanied by a portion of lower jaw containing the last premolar and the succeeding two true molars.

The specimen agrees with the preceding, except that the face is more flat above so as to appear of less depth, and in transverse section more square.

From Messrs. Culbertson's collection.

MEASUREMENTS.

	Inches.	Lines.
Breadth of face at infra-orbitar foramina	1	6
Breadth of face above the first premolar	1	6
Height from infra-orbitar foramina to angular processes of os frontis	1	2½
Breadth of ossa nasi between the points of the latter processes		11½

5. A portion of a very much mutilated skull, with attached fragments of both sides of the lower jaw widely extended from the upper teeth. Upon one side the specimen contains all the upper true, and the lower posterior two true molars, and on the other side the upper posterior two and the last lower molar teeth.

From Messrs. Culbertson's collection.

MEASUREMENTS.

	Inches.	Lines.
Length of series of upper true molars	1	11
Antero-posterior diameter of the upper last molar		10
Antero-posterior diameter of the lower last molar	1	

6. A fragment of the right side of the face of a young animal, containing a portion of the first, the entire second, and the inner portion of the third temporary molars, and the succeeding two permanent molars.

It was this specimen to which I applied the name *Cotylops speciosa*, erroneously supposing it to be distinct from *Oreodon*.

From Capt. Van Vliet's collection.

7. Thirteen fragments of upper and lower jaws, all containing from one to three true molars, except one, in which are preserved the anterior two lower premolars. They apparently belonged to seven different individuals.

From the collections of Dr. Owen, Capt. Van Vliet, Dr. Prout, Prof. O'Loghland, and Messrs. Culbertson.

8. A portion of the right side of the lower jaw of a young animal, with the remains of the anterior two temporary premolars; the entire temporary true molar, considerably worn; and the succeeding two permanent molars. (Pl. VI. 10, 11.)

From the collection of Capt. Van Vliet.

9. A nearly entire skull, comparatively slightly fractured, and wanting only the end of the nose anterior to the canines, the upper of the latter, the incisors, zygomata and post-orbital arches, a portion of the parietal crest, and the right angle of the lower jaw.

Its details of form vary in a very slight degree from those of specimen 1. In the latter, it was observed in the table of measurements, a hiatus of one and a

half lines in extent existed between the canines and incisors, but in the specimen under inspection no hiatus existed in a corresponding position of the lower jaw, the lateral incisor having been in contact with the canine. (Plate II. Fig. 2.)

From the collection of Dr. David Dale Owen.

MEASUREMENTS.

	Inches.	Lines.
Breadth of face at infra-orbitar foramina	1	6¼
Breadth of face above first premolar	1	3
Distance from infra-orbitar foramina to frontal angular processes	1	4
Breadth of ossa nasi at the points of the latter processes		8¾
Length of series of upper molars	3	4¼
Length of series of lower molars	3	4
Length of series of upper true molars	1	10
Length of series of lower true molars	2	½

10. A skull with the anterior extremity of the nose, the zygomata, and summit of inion broken away. The forehead is slightly crushed, but otherwise the specimen is comparatively well preserved. It contains all the molar teeth of both sides, the left canine, and the fang of the right canine. A small fragment of the right side of the lower jaw, containing the true molars, accompanies the former specimen.

The skull I suspect to have belonged to a male individual of *Oreodon Culbertsonii*, on account of its generally more robust character than most of the others which have been indicated; and specimen 9, particularly, I suppose to have belonged to a female.

Besides the relatively greater degree of robustness of the male skull of *Oreodon Culbertsonii*, the face is depressed or flattened above, or is not so much arched as in the female, and in transverse section it has a more square than conoidal appearance, as in the latter. The molar teeth, also, are more robust, and the true molars possess a well-developed ridge between the bases of the external columns or buttresses, and a feebler ridge exists externally at the base of the premolars. The canines are a little more robust, a little longer, and project a trifling degree more outwardly.

In the specimen under immediate inspection, the supra-orbitar foramina are nearer the centre of the forehead on each side than in any of the preceding.

The parietal region on one side of the sagittal suture presents an irregularly eroded and areolated vascular appearance, with several slight thin exostoses, indicating inflammation to have existed during the life of the animal. (Plate III. Figs. 1, 2.)

From the collection of Dr. Owen.

MEASUREMENTS.

	Inches.	Lines.
Breadth of face at infra-orbitar foramina	1	7½
Breadth of face above first premolar	1	7½
Distance from infra-orbitar foramina to frontal angular processes	1	4
Breadth of ossa nasi at the ends of the latter processes		9½
Length of series of upper molars	3	7½

	Inches.	Lines.
Length of series of upper true molars	1	11½
Antero-posterior diameter of last upper molar		9½

11. The facial portion of a skull, apparently of a male, containing all the molars except the crown of the first premolar. In section, it presents the same squareness of character as in specimen 10, and also has the same flatness above and uniformity of breadth anteriorly. The ossa nasi have been slightly shorter than those in specimen 10, and less rounded posteriorly.

The specimen is remarkable in comparison with that last indicated, because the true molars are a little smaller and the premolars a little larger; but this increase of the latter is in breadth, and not antero-posteriorly, so that it produces no effect upon the length of the series.

The basal ridge of the molars is more feebly developed internally than in specimen 10, and externally it is obsolete.

The hard palate is slightly more arched, and has a little greater breadth than in specimen 10.

From Capt. Van Vliet's collection.

MEASUREMENTS.

	Inches.	Lines.
Breadth of face at infra-orbitar foramina	1	7½
Breadth of face above first premolar	1	7½
Distance from infra-orbitar foramina to frontal angular processes	1	2
Breadth of hard palate posteriorly	1	5
Breadth of hard palate anteriorly	1	4
Extent of hiatus posterior to the upper canine		2½
Length of series of upper molars	3	5
Length of series of upper true molars	1	9
Antero-posterior diameter of last upper molar		9

12. A fragment of the face and forehead. The former in transverse section is nearly square, but is rather more arched above than in specimen 10, and is narrower and less deep than usual.

From Dr. Owen's collection.

MEASUREMENTS.

	Inches.	Lines.
Breadth of face at infra-orbitar foramina	1	5½
Breadth of face above first premolar	1	4¾
Distance from infra-orbitar foramina to frontal angular processes	1	½
Breadth of ossa nasi at the ends of the latter processes		11

13. A portion of the face and forehead of an individual just arriving at adult age. Though very imperfect, the specimen is an instructive one, as it exhibits the order of succession of the permanent to the temporary molar teeth.

Upon the right side, the last molar is preserved and fully protruded, and has the enamel summits of its anterior lobes slightly worn. The second true molar has the dentine exposed upon the summits of the lobes; most so upon that antero-

internal, and least so upon that postero-internal. Of the first true molar the inner half alone is preserved, and presents the corresponding lobes with broad crescentic surfaces of dentine.

The socket of the fourth premolar had lost its tooth, and is now filled with matrix.

Portions of the crowns of the third and second premolars, yet remaining, indicate that these teeth had not been protruded from the gums.

From this account, it appears that all the permanent true molars are fully protruded before the temporary molars are shed.

The two entire teeth above indicated, are in this specimen a trifling degree smaller than in specimens 1 and 10, and yet the fragment of skull, though not of a fully adult animal, is larger than the corresponding portion of any of the preceding specimens described. In the upper view, it appears as if it had belonged to a distinct species from *Oreodon Culbertsonii*, and had it been the only specimen in the collection besides the first indicated in the list, I would have so considered it without hesitation, but, from the many variations presented in numerous individual cases, I am inclined to think it is only a variety.

The forehead is unusually long and broad; being about three-fourths of an inch greater in the former direction than in the largest specimen previously indicated. The supra-orbitar foramina are removed to double their usual distance from the fronto-nasal suture, or rather they appear to occupy the ordinary position, while the portion of the os frontis in advance of them is unusually prolonged. The lachrymal depression, also, is more shallow than usual, apparently by the spreading or expansion of the lachrymal bone; for the outer face of this is several lines higher and broader than in the preceding specimens.

From the collection of Dr. Owen.

MEASUREMENTS.

	Inches.	Lines.
Distance of infra-orbitar foramina from frontal angular processes . . .	1	6
Distance of supra-orbitar foramina from fronto-nasal suture	1	2
Length of series of upper true molars	1	9
Antero-posterior diameter of last molar		8

14. A fragment of a face of a young animal, containing on both sides portions of the temporary molars; the succeeding two permanent true molars; and, concealed within the jaw, the last molar.

From the collection of Dr. Owen.

15. The greater portion of a face and lower jaw, containing all the molars except one of both sides. It presents nothing peculiar, except a slight variation in details of size.

From the collection of Dr. Owen.

MEASUREMENTS.

	Inches.	Lines.
Breadth of face at infra-orbitar foramina	1	8
Distance from infra-orbitar foramina to frontal angular processes	1	4
Length of series of upper molars	3	1
Length of series of lower molars	3	
Length of series of upper true molars	1	8
Length of series of lower true molars	1	10

16. The skull of a young animal, accompanied by the greater portion of the left side of the lower jaw. The end of the nose and superficial portion of the right side of the face are broken away. The upper jaw, on the right side, contains all the molars perfect; consisting of the first permanent premolar and the succeeding three temporary and two true molars protruded, and the last true molar just on the point of protrusion. The portion of lower jaw also contains all the molars nearly perfect; consisting of three temporary molars and three permanent true molars, the last of which is only partially protruded.

Independently of the specimen not being adult, it evidently indicates a smaller individual of *Oreodon Culbertsonii* than any of the others previously designated. (Plate V. Figs. 1, 2.)

From the collection of Dr. Owen.

MEASUREMENTS.

	Inches.	Lines.
Length from occipital condyle to canine alveolus	6	
Length of series of upper molars	3	1
Length of series of lower molars	3	
Length of series of upper permanent true molars	1	8
Length of series of lower permanent true molars	1	10
Antero-posterior diameter of last upper molar		$7\frac{3}{4}$
Antero-posterior diameter of last lower molar		9

17. Fragment of the left side of the lower jaw of an old individual, containing the true molars and the two premolars in advance, with the characteristic enamelled triturating surfaces nearly obliterated. (Plate VI. Figs. 8, 9.)

From the collection of Dr. Owen.

MEASUREMENTS.

	Inches.	Lines.
Length of series of true molars	1	9
Antero-posterior diameter of last molar		10

18. Seven fragments of upper and lower jaws, containing true molars, apparently from six different individuals.

From the collection of Dr. Owen.

19. A skull, without the lower jaw, and with the end of the nose and posterior part of the cranium broken away. It is particularly valuable from its preserving the post-orbital arch entire on both sides. The teeth are all broken. (Plate IV. Fig. 3.)

From the collection of Dr. Hiram A. Prout, of St. Louis.

20. Fragments of the upper and lower jaw, the former containing the last two molars, the latter the last three molars. Upon these was originally established the *Merycoidodon Culbertsonii*, in the Proceedings of the Academy of Natural Sciences (vol. iv. p. 47. Plate: Figs. 1–5).

The specimens were collected by Mr. Alexander Culbertson, and presented to the Academy of Natural Sciences by his father Mr. Joseph Culbertson.

Average Measurements of Specimens of OREODON CULBERTSONII; *but principally taken from the female head represented in Plates II. and IV. Figs.* 1, 2.

	Inches.	Lines.
Length of skull from occipital condyles to incisive alveoli in the female	7	4
Length of skull from occipital condyles to incisive alveoli in the male	7	9
Length of face from antero-orbital margin to incisive alveoli	3	6
Length from post-glenoid tubercle to incisive alveoli	6	6
Length from hinder part of last molar to incisive alveoli	4	3
Length from inion to coronal suture	2	10
Length from coronal suture to end of nose	4	8
Length of os frontis at middle	1	10
Greatest breadth of skull at zygomata	4	2
Greatest breadth at inter-temporal region, near middle	1	7
Least breadth at coronal suture	1	3
Breadth at middle of post-orbital arches	3	3
Breadth of face above last molar	2	9
Breadth of face above first premolar	1	4
Breadth of face at infra-orbitar foramina	1	7
Breadth between ends of frontal angular processes		9
Breadth of each nasal bone		5
Vertical diameter of the orbit	1	3
Transverse diameter of the orbit	1	1
Greatest length of lower jaw	6	2
Height of lower jaw at coronoid process	3	3
Height of lower jaw at condyle	2	9
Height of lower jaw at last molar	1	7
Height of lower jaw at second premolar	1	1
Length of series of upper molars	3	4
Length of series of lower molars	3	3
Length of series of upper true molars	1	10
Length of series of lower true molars	2	
Antero-posterior diameter of last upper molar		9
Antero-posterior diameter of last lower molar		11
Antero-posterior diameter of penultimate lower molar		7
Antero-posterior diameter of upper premolars		5
Antero-posterior diameter of lower premolars		5½
Length of crown of upper canine	male 9 lines; female 7	
Length of crown of lower canine		6¾
Breadth of lateral series of upper incisors		7½
Breadth of lateral series of lower incisors		9
Length of crown of upper internal incisor		3½
Length of crown of upper lateral incisor		4¼
Length of crown of lower internal incisor		3¾
Length of crown of lower lateral incisor		5

The species is respectfully dedicated to the Messrs. Culbertson, through whose aid the first specimens were obtained upon which the genus was established.

Oreodon gracilis, Leidy.

(Pl. V. Figs. 3, 4; VI. Figs. 1–7.)

Oreodon gracilis, Leidy: Proc. Acad. Nat. Sci., 1850, v., 239; Owen's Rep. of a Geol. Surv. of Wisc., etc., 550.

Merycoidodon gracilis, Leidy: Owen's Rep., 550.

This species was first characterized in a verbal communication to the Academy of Natural Sciences in August, 1851, from several fragments of an upper and a lower jaw containing the true molars and one premolar.

The head is about two-thirds the size of that of *Oreodon Culbertsonii*.

The specimens, which I have had the opportunity of examining, are as follows:—

1. Lower and upper jaws, occiput, and os frontis of an old individual. The rami of the lower jaw are broken away, but on the left side it contains all the true molars, the third premolar, and the fangs of those in advance. The right side of the upper jaw contains the true molars, the fourth premolar, and the roots of those anterior. (Plate VI. Fig. 4, the lower jaw; Fig. 5.)

From the collection of Captain Van Vliet.

MEASUREMENTS.

	Inches.	Lines.
Length of series of upper molars	2	2
Length of series of lower molars	2	2
Length of series of upper true molars	1	2½
Length of series of lower true molars	1	4
Distance between ends of frontal angular processes		4¾
Distance between supra-orbitar foramina		5½

2. The skull of an adult, with the end of the nose, base of the cranium, and zygomata broken away. It contains upon the right side the true molars and the fourth premolar, and on the left, fragments of all the molars. Accompanying it is a portion of the lower jaw, containing the true molars. (Plate VI. Figs. 1–3.)

From the collection of Drs. Owen and Evans.

MEASUREMENTS.

	Inches.	Lines.
Breadth of cranium above roots of zygomata	1	6
Breadth of cranium at most prominent part of the temporal fossæ	1	4
Distance from bifurcation of sagittal crest to ossa nasi	1	6½
Distance between supra-orbitar foramina		3½
Length of series of upper true molars	1	3
Length of series of lower true molars	1	4

3. A facial fragment containing on the left side the last two molars, the fangs of all those in advance, and that of the canine. It is particularly valuable from the left orbit being preserved entire.

The specimen corresponds in its proportions and details with specimen 2. (Plate VI. upper part of Fig. 4.)

From the collection of Dr. Owen.

MEASUREMENTS.

	Inches.	Lines.
Length of series of upper molars	2	1
Breadth of face at infra-orbitar foramina		11½
Distance between supra-orbitar foramina		4
Distance between frontal angular processes		8½

4. The skull accompanied by the right side of the lower jaw of a young animal. The former has the posterior and superior portions of the cranium and the nose broken away; the latter the ramus and symphysis.

The upper jaw contains on the left side the molar series nearly complete, consisting of the first permanent premolar, the temporary molars, and the succeeding two permanent true molars which are fully protruded.

The portion of lower jaw contains two temporary molars, and the succeeding two permanent molars.

The forehead of this specimen is remarkable for its flatness; being much more arched in the adult. (Plate V. Figs. 3, 4; VI. Figs. 6, 7.)

From the collection of Dr. Owen.

Average Measurements of Specimens of OREODON GRACILIS.

	Inches.	Lines.
Estimated length from summit of inion to incisive alveoli	4	8
Breadth below the orbit at the maxillo-malar suture	2	5
Breadth of cranium at most prominent portion of temporal fossæ	1	4½
Breadth of cranium at narrowest portion		10½
Estimated length of sagittal crest	1	10
Length of forehead in median line	1	7
Breadth of forehead at middle of post-orbital arches	2	2
Breadth of face from above the lachrymal tubercle	1	7
Breadth of face at infra-orbitar foramina	1	
Breadth of face between ends of frontal angular processes		8½
Height from middle palate suture to fronto-nasal	1	3½
Height from middle palate suture on a line with the first premolar	1	½
Diameter of the orbit		9
Breadth of palate between fourth premolars		8½
Depth of lower jaw at last molar	1	
Depth of lower jaw at third premolar		8
Length of series of upper molars	2	1
Length of series of lower molars	2	1½
Length of series of upper true molars	1	2½
Length of series of lower true molars	1	4
Antero-posterior diameter of upper middle true molar		5
Antero-posterior diameter of upper fourth premolar		3
Antero-posterior diameter of last lower molar		7½
Antero-posterior diameter of second lower true molar		5½
Antero-posterior diameter of third lower premolar		4

Comparison between OREODON CULBERTSONII *and* OREODON GRACILIS.

Besides the great disproportion in size between *Oreodon Culbertsonii* and *Oreodon gracilis*, (the latter being nearly one-third less than the former,) there are other differences which, though slight, are important.

In *Oreodon Culbertsonii*, the sagittal crest rises from the sides of the temporal fossæ in a gradual pyramidal manner; but in *Oreodon gracilis*, the intertemporal region at its upper part is more arched, and the sagittal crest rises from it in the form of a thick, abrupt, rugged, linear ridge.

In the latter species the lachrymal depressions are relatively less deep, and the entrance of the orbits more nearly circular.

The posterior convergent extremities of the ossa nasi terminate more abruptly in *Oreodon gracilis;* or in this they are convex and in *Oreodon Culbertsonii* are angular.

The ossa tympanica are relatively much more inflated in *Oreodon gracilis;* and the prominent ridge continuous from them to the auditory process in *Oreodon Culbertsonii*, is but feebly developed in the former species.

Oreodon major, LEIDY.

(PL. IV., Fig. 6.)

Syn. *Merycoidodon major.*

A third species of *Oreodon* with some hesitation is proposed upon a fragment of the right side of the upper jaw, containing the true molars, from the collection of Dr. Owen.

The specimen belonged to a middle-aged individual, as indicated by the trituration to which the teeth have been subjected in mastication; the characteristic enamelled grinding surface of the first true molar being quite obliterated.

The teeth correspond closely in form with those of *Oreodon Culbertsonii*, but they are much larger than any of the specimens which have been attributed to the latter.

It is not improbable, that upon further investigation, the specimen may prove to belong merely to a large variety of *Oreodon Culbertsonii*, for the difference in size of the teeth from those indicated in the specimen 10, of the latter species, is not as great as that existing between the teeth of this and those of specimen 16.

MEASUREMENTS.

	Inches.	Lines.
Length of series of upper true molars	2	$3\frac{3}{4}$
Antero-posterior diameter of the last molar	1	
Breadth anteriorly		11

EUCROTAPHUS, Leidy.

Eucrotaphus Jacksoni, Leidy.

(Plate VII. Figs. 4–6.)

Eucrotaphus Jacksoni, Leidy: Proc. Acad. Nat. Sci., 1850, v. 92.

Eucrotaphus auritus, Leidy.

(Plate VII. Figs. 1–3.)

Eucrotaphus auritus, Leidy: Owen's Rep. of a Geol. Surv. of Wisc., etc., 563.

The genus *Eucrotaphus* was originally proposed in the Proceedings of the Academy of Natural Sciences of Philadelphia, upon a cranial fragment presented to the Society by Mr. Alexander Culbertson through his father, Mr. Joseph Culbertson.

The specimen is remarkable for the great relative size of the pars squamosa of the temporal bone; being hardly equalled in this respect by that of the Camel or of *Oreodon*.

The family to which *Eucrotaphus* belongs has not yet been ascertained with certainty, though from the form and proportions of the cranium being so very much like those of *Oreodon*, I suspect it to have appertained to the ruminantia.

Coincidentally, Dr. Owen's collection contains the portion of a cranium corresponding to that just indicated; but it belongs to a different and rather larger species.

Besides the foregoing, no specimens have been discovered, which can be ascertained to belong to *Eucrotaphus*. From the similarity in construction of the cranium proper of the latter and of *Oreodon*, and from the decided ruminant characters of the specimens upon which *Agriochoerus* has been proposed, with the relations of size which these bear to those of *Eucrotaphus*, I suspect the latter two are in reality the same genus.

To the smaller species of *Eucrotaphus*, the head of which was about the size of that of *Oreodon Culbertsonii*, the name *Eucrotaphus Jacksoni* was given in honor of my much esteemed and distinguished friend Dr. Samuel Jackson, Professor of the Institutes of Medicine in the University of Pennsylvania.

For the second species the name *Eucrotaphus auritus* is proposed, from the relatively larger size of the auditory bullæ.

It is unnecessary to describe in detail the specimens upon which the two species are founded, for they agree so closely with the corresponding portion of the skull of *Oreodon*, that it is sufficient to point out the peculiarities of structure which distinguish them from the latter and from each other.

The lateral and upper views of the cranium proper of *Eucrotaphus* (Pl. VII. Figs. 1, 2, 4, 5,) are identical with those of *Oreodon*, except, perhaps, the pars squamosa is a trifling degree larger in the former, and the parietalia are rather more depressed in advance and upon the course of the squamous suture.

The outline of the base view (Figs. 3, 6), and the position of the foramina are also the same as in *Oreodon;* but in *Eucrotaphus*, the glenoid articulation is rather

deeper; the post-glenoid tubercle is shorter and relatively very much more robust; and the os tympanica, instead of being slightly swollen at the inner termination of the vaginal crest of the auditory process, as in the former, is developed into a bulla relatively as large as in the Californian Deer.

In *Eucrotaphus Jacksoni* (Fig. 6), the auditory bulla forms a large, simple mammillary eminence, which abuts against the sphenoid bone anteriorly and the paramastoid process posteriorly, and rests with its base internally upon the margin of the basilar process and the conjunction of this with the sphenoidal body, and is outwardly continuous with a ridge the homologue of the vaginal process.

In *Eucrotaphus auritus* (Fig. 3), the auditory bulla has the same connections as in the former, but in addition rests against the post-glenoid tubercle; and it is relatively slightly larger, and laterally compressed.

Fam. 2.—Paridigitata Ordinaria.

Gen. **ARCHAEOTHERIUM,** Leidy: (*Entelodon?* Aymard.)

Archaeotherium is a remarkable genus of suilline ungulata combining apparent ruminant and carnivorous characteristics. In the form of its superior molar teeth it exhibits an affinity to the extinct *Choeropotamus*, Cuvier, and in a less degree to the *Hyracotherium*, Owen; but, judging from a sketch in Gervais's Zoologie et Paleontologie Françaises,[1] of the upper molars of *Entelodon*, Aymard, it approaches this much more nearly than either the former. Indeed, the posterior five superior molars of *Entelodon* and *Archaeotherium* are so alike in relative position, proportion, and form, that I consider it doubtful whether the latter is distinct from the former; but not having an opportunity of examining the original descriptions and figures of Aymard,[2] nor of extending the necessary comparisons, I have provisionally retained the generic name originally proposed.

Archaeotherium Mortoni, Leidy.

(Plate VIII; IX; X. Figs. 1–7.)

Archaeotherium Mortoni, Leidy: Proc. Acad. Nat. Sci., 1850, v. 92; Owen's Rep. of a Geol. Surv. of Wisc., 558.
Archaeotherium (*Entelodon?*) *Mortoni*, Leidy: Owen's Rep. etc., refer. to Table X.

The species *Archaeotherium Mortoni* was established in the Proceedings of the Academy of Natural Sciences (Vol. V. p. 92, for 1850), upon a fragment of a face containing the third and fourth premolars of the left side, presented to the Academy by Mr. Alexander Culbertson.

Later, I have been enabled very greatly to extend our knowledge of this animal by the investigation of several interesting specimens in the collection of Dr. Owen.

One of these is a portion of the face very much mutilated, of an adult individual,

[1] P. 102, p. 2, 26, fig. 12.

[2] Mem. Soc. Agric. Sci., etc., du Puy, t. xii. p. 240; 1848. *Gervais.*

containing, on both sides the anterior two true molars, and the fangs of the last molar and of the last premolar. The other specimen, much the most important, consists of the greater portion of the skull of a young animal, in which the anterior two permanent true molars had protruded, but all the other permanent molars were yet concealed within the jaw. It is broken into two pieces, and is accompanied by fragments of both sides of the lower jaw. The upper part of the face, left orbit, and left zygoma are broken away, but upon the right side the latter two are almost perfect. The upper jaw, in its present condition, contains upon the left side the posterior five permanent molars (those concealed within the jaw having been artificially exposed), and upon the right side, the permanent true molars and the posterior two temporary molars. The fragments of the lower jaw consist of one of the left side containing the posterior five molars, of which the first and last had not yet protruded; and two of the right side, of which one is the angular portion, and the other contains the last temporary molar, the permanent last premolar and the first and last permanent true molars.

Description of the Skull.—The form of the head of *Archaeotherium Mortoni* is so peculiar that I know of none among existing ungulata with which to compare it. In viewing it from above, it resembles more in general configuration that of the Lion or other species of *Felis*, than it does that of any of its own tribe now in existence. From the head of the Lion, however, it differs in numerous important points, among the most striking of which, are, the uniform height forward of the sagittal crest, the recession of the temporal fossæ, the verticality of the zygomatic root, the existence of a post-orbital arch as strong as that of the Camel, the verticality of the orbital entrance, the relatively great size and depressed character of the forehead, the extent of the lachrymal bone, the more prolonged and demi-cylindroidal form of the face, the advanced position of the infra-orbital foramen, etc.

Lateral View.—(Pl. IX., Fig. 1.) In the side view of the head, the upper outline descends slightly from the inion, then rises towards the forehead, and again descends along the face as in the Lion, but relatively not to the same extent. The outline of the inion appears more oblique than in the Peccary, and is intruded upon by the occipital condyles and a vertical convex prominence above them.

The temporal fossa is quite transverse in its direction in comparison with that of the Hog and Peccary, and, as in these, its position is more posterior than in the Lion; but it is relatively longer and less deep than in the former animals, and is as much more capacious than these, as is that of the latter animal. Its increased capacity is not only produced by extension upward upon a strongly developed parietal crest, but also, as in the *Choeropotamus* and Lion, by the greater extension outwardly of the zygoma than in the Hog or Peccary.

The root of the zygomatic process in association with the mastoid and paramastoid processes forms a remarkably strong scroll-like apophysis, which protrudes directly outward from the lateral margin of the inion, and expands like the mouth of a trumpet, is open below; and it leads to the meatus auditorius. Its anterior surface is an almost vertical convexity, nearly two inches in depth, and contributes very greatly to the extent of attachment of the powerful temporal muscle. Externally, the zygomatic process becomes abruptly narrowed to less than half the depth of its

root, and from this position it turns directly forward and terminates by resting upon a long rectangular notch of the malar bone.

The posterior half of the outer surface of the zygoma forms a nearly vertical plane; but anteriorly, where formed by the malar bone, it is remarkable for its extraordinary depth; being over two inches, and is vertically plane above, but slightly bent outwardly below.

In the specimen, the sagittal crest is broken at the inion and along its free margin, but it is yet sufficiently entire to exhibit the remarkable uniformity of its height in comparison with that of the Camel and Lion. Posteriorly, as in the two latter, it has the appearance of having contributed to the formation of a strong process overhanging the inion, but it is not as concave laterally as in either of these animals.

The margin of the temporal fossa bordering upon the inion is acute, but forms no trace of a projecting crest.

The post-orbital process of the os frontis is as thick and strong as in the Camel; and, as in this, has nearly the same direction outward and backward, and it joins an equally short and strong process of the os malæ.

The temporal surface along the sagittal crest is concave, but below the base of this is uniformly convex in the vertical direction.

The orbit is relatively larger than in the Hog or Peccary, and is broader below; is vertical and ovoidal at its entrance, and is directed outward and forward at an angle of about 45°. Its superior margin is prominent and obtuse, and the lachrymal border forms a simple, compressed mammillary eminence, bounded above and below by a rounded notch. Just internal to the lower notch is a single lachrymal foramen. Below the orbit the malar bone is remarkably shallow, and its surface, from the infra-orbital margin, slopes outward, downward, and backward.

The post-orbital arch is even relatively stronger than in the Camel, and has about the same form. The possession of this arch by *Archaeotherium* is a remarkable peculiarity, as it does not exist in the closely allied *Choeropotamus*, nor in any of the recent suilline genera, except as an inconstant characteristic in the *Hippopotamus*.

The side of the face is vertically convex, and is directed forward in a straight line from the position of the termination of the malar bone.

The outer face of the lachrymal bone is slightly bent and nearly plane and vertical. The infra-orbitar foramen is vertically oval, and is situated above the position of the penultimate premolar, and nearly three inches in advance of the orbit.

Superior View.—(Pl. IX. Fig. 2.) In the upper view of the head of *Archaeotherium*, the cylindrical form of the interparietal region, bounded above by the high sagittal crest, is a striking peculiarity of the genus.

Between the zygomata the breadth of the head is relatively greater than in feline animals.

The space inclosed by the zygomatic arches is as capacious as in the Lion, but is relatively a little longer and not quite so broad, and is oval in form.

The forehead and prognathous face much resemble those of the *Hyracotherium*.

The former is relatively broad compared with that of the Hog and Peccary, and in this character and in its form is more like that of the Camel.

The sagittal crest at its bifurcation is, to an extraordinary degree, strong and prominent, and the fronto-temporal ridges leading from them are at first elevated and acute, but afterwards decline and become irregular in their course outwardly.

The forehead presents a rugged appearance; is prominently convex on each side above the orbits, and is deeply depressed in the middle. In the greater part of one side remaining in the specimen, over the orbit, are two small vasculo-neural foramina; and near the middle line and the fronto-nasal suture, is a fronto-orbital foramen, which is relatively very small to that of the Hog or Peccary. The face has the form of a demi-cylinder very slightly convergent forward. Its upper part in the latter direction forms a very slightly concave slope similar to that existing in the same position in the *Dicotyles labiatus*.

Posterior View.—(Pl. X., Fig. 6.) The inion forms a broad triangle, from the middle of the base of which the occipital condyles project downward and backward, and these have very nearly the same form and relation to each other as in the Hog.

Above the condyles the occiput forms two vertical convex prominences separated by a concavity which extends to the summit of the inion, as in the Hog and Peccary, but is deeper than in these. Laterally, the inion is depressed into a deep pit, at the bottom of which is a large foramen communicating with the interior of the cranium, as in the Camel.

Inferior View.—(Pl. VIII., Fig. 1.) The base view of the skull bears considerable resemblance in its form to that of *Choeropotamus;* but posteriorly it is relatively broader, from the greater degree of extension outwardly of the zygomata.

The basilar process is demi-cylindroidal, convergent anteriorly, and terminates in two lateral abutments, which rest against a corresponding pair extending as lateral ridges from the post-sphenoidal body.

The post-sphenoidal body at its middle forms a concave gutter, and anteriorly terminates at the orifice of a very large azygous canal, which also exists in the Hog, but in a relatively feebly developed condition.

The anterior condyloid foramen occupies a position at the bottom of the concave lateral portion of the basilar process, a few lines in advance of the condyle.

In front of the latter foramen is a large, irregularly crescentic foramen lacerum, which surrounds the inner side of the auditory bulla.

The foramen ovale is situated in front and at the extreme bottom of the zygomatic root. The foramen spheno-orbitale is placed about three-fourths of an inch in advance of the ovale, is circular, and is bounded externally by a prominent acute ridge, which curves upward and forward, and constitutes the antero-inferior limit of the temporal fossa.

The optic foramen is relatively about as large as that in the Hog, and is situated about three lines anterior to the one last described.

The homologues of the paramastoid processes or the inferior angles of the occiput are thick and strong, and are prolonged in a curvilinear manner outward and downward. In the specimen they are broken at their extremity, and they are associated with the mastoid processes, considerably external to the position of the

occipital condyles, and constitute the posterior part of the infundibular expansion of the root of the zygomatic process.

The auditory bullæ, broken in the specimen, appear to have been broad and convex, but compared to those in recent suilline animals were feebly developed. A strong conoidal process projected from them anteriorly downward and forward, bounding the passage of the Eustachian tube externally, and the foramen caroticum internally. Externally, the auditory bullæ are prolonged into a broad and strong auditory process.

The external auditory meatus is circular, is relatively considerably larger than in the Hog, and is remarkable for the large infundibular expansion which leads to its entrance.

The inferior border of the root of the zygomatic process is thick and convex, and is prolonged outward and downward to the glenoid articulation.

The latter in position and form resembles that of the Peccary; but it is relatively broader and more shallow, or its anterior and posterior tubercles are shorter.

From the glenoid articulation, the zygoma converges to the face and expands outward and downward; and where constituted by the antero-inferior margin of the malar bone, it forms a prominent acute edge.

The posterior palatine notch, as in the Tapir, *Rhinoceros,* and extinct *Choeropotamus*, extends to some part of the space intervening to the penultimate molar teeth. It is about three-fourths of an inch wide at its commencement, and has nearly parallel sides and a concave bottom.

The hard palate is concave, and parallel at its sides, and is not roughened as far as preserved in the specimen.

The palate plates of the palate bones are short, as in the Hog; and the posterior palatine foramina are situated in the transverse palatal suture.

Form, Relations, and Connections of the Bones of the Skull.—The parietalia are fused at the sagittal crest into a single symmetrical bone, which descends on each side in advance of the pars squamosa, to the bottom of the temporal fossa to join the sphenoid bone, and anteriorly is notched for the adaptation of the os frontis.

The pars squamosa of the temporal bone appears to be almost entirely extended outwardly to form the deep anterior face of the root of the zygomatic process; and its suture descends so rapidly that its most anterior part is only a little over an inch from the position of the meatus auditorius.

The os frontis, even in the young animal, is single, and it contributes to nearly one-third of the extent of the temporal surface. Anteriorly, it terminates in angular processes, which extend in advance of the ossa lachrymalia, and for more than two inches along the sides of the ossa nasi.

The bottom of the fronto-nasal suture is nearly on a line with the anterior margin of the orbits, from which position the ossa nasi gradually widen to the points of the angular processes of the os frontis, and then, in the specimen, in a more gradual manner decrease in width to their broken extremities.

The facial surface of the lachrymal bone forms an oblong square measuring nearly two inches antero-posteriorly.

The maxillo-malar suture descends in the same oblique line, as that anterior to

the lachrymal bone, to about the middle of the position of the penultimate molar tooth.

Inferior Maxilla.—Of the lower jaw we have the opportunity of examining only several small fragments, but fortunately these are important ones, as from the form of the superior molar teeth resembling very closely those of *Choeropotamus*, we might expect to find a lower jaw constructed like that of this animal, which is far from being the case. One of the fragments consists of the posterior extremity of the right side, externally attached to a mass of matrix. (X. 7.) The coronoid process and condyle are broken, but they appear to have preserved their relative proportion and position to one another, which are as in modern suilline animals. The technical angle, which is preserved entire, is not prolonged into a hook as in *Choeropotamus*, nor is it rounded as in the Hog and Peccary, but is almost rectangular, and lengthened slightly backward and downward, as in the Deer; and it is thick and convex at the apex. The ascending ramus is broad, and, as in the Hog, is apparently not depressed to any extent in advance of the position of the condyle. The posterior border of the jaw is vertically concave; and, indeed, excepting the condyle and coronoid process, the posterior part of the bone partakes of the form of that of the Hog and Deer.

The other fragments are portions of the lower jaw of both sides containing molar teeth; and are two inches in depth below the position of the first true molar. That of the right side is an exceedingly interesting and important piece (VIII. 2), for, as in *Anthracotherium*, it has a short obtuse process projecting from the base of the bone. The direction of the process is outward and downward, and it is situated below the position anteriorly of the last permanent premolar. From the outward curve of the process the jaw above and on a line with it is concave.

Dentition.—Of the permanent dentition of *Archaeotherium* we are acquainted only with the posterior five upper molars, and the posterior four below. These are constructed upon an undoubted suilline type, but approach none of the recent forms so much as they do those of *Hyracotherium*, or more those of *Choeropotamus*, and most, if they are not identical with, those of *Entelodon*.

In the specimens, the molar teeth above mentioned form a close row in both jaws, and their relation to one another is the same as in the Hog, Peccary, or *Hippopotamus*.

Superior Molars.—(VIII. 2; IX. 1, 3–5; X. 1.) The upper true molars are constructed after the same type as those of *Choeropotamus* and *Hyracotherium*, but differ principally in the less extent of development of the basal ridge.

The crowns of the anterior pair of true molars are quadrate with convex sides, and internally as in *Entelodon magnum* have no basal ridge like that existing in the other two genera mentioned. The grinding surface of these teeth presents two transverse rows, each of three conical lobes, of which those external and that antero-internal are the larger, and are nearly equal in size; and the remainder are subequal.

The enamelled sides of the lobes are corrugated and their apices are excavated, though feebly, compared with what they are in *Hyracotherium* and *Choeropotamus*.

Anteriorly, the crowns are embraced by a strong and deep basal cingulum or ridge, relatively more robust than in any of the allied genera.

In the first true molar a strong basal ridge passes in a festooned manner from the apex of the postero-internal lobe posteriorly to the base of the corresponding external lobe, and from this externally to the base of that in advance, but does not embrace it as in *Entelodon magnum*.

In the second true molar, as in the corresponding tooth of *Entelodon magnum*, the apex of the postero-internal lobe is continuous with a thick basal ridge ascending posteriorly from the base of the postero-external lobe; but no ridge exists externally upon the tooth as in the latter animal.

The last of the true molar series has a quadrilateral oval crown, presenting as in the teeth described, an anterior row of lobes, bounded at base anteriorly by a similar but shorter and more tuberculated basal ridge. The posterior third of the triturating surface is composed of an assemblage of four low tubercles, which correspond to the posterior lobes and basal ridge of the two molars in advance.

The posterior two premolars are not at all like those of *Hyracotherium*, but are constructed upon the same pattern as those of *Choeropotamus*, and are very much like those of *Entelodon magnum*.

As in the latter, the last premolar has a quadrilateral crown with the inner side shortest and that anterior oblique. It is composed of a transverse pair of conical lobes, of which the internal is the smaller, and both are very much larger than the homologous constituents of the true molars. Posteriorly they are associated by a strong basal ridge, a portion of which exists also at the anterior part of the outer lobe, but no portion exists internally and externally as in *Entelodon magnum*.

The crown of the penultimate premolar forms a single, large, laterally compressed conoidal lobe, resembling very much that of a corresponding carnivorous tooth. It is relatively greater antero-posteriorly, and is narrower than that of *Choeropotamus*, and is very much like that of *Entelodon magnum;* but, judging from Gervais's sketch of this tooth of the latter, is more uniform in its transverse diameter. Externally it is convex, and in its direction downward curves slightly backward. Its anterior margin is convex, but posteriorly it presents a salient margin separating the external and internal faces. Posteriorly, the internal face towards the base of the crown is rugged, and anteriorly it presents a portion of a basal ridge, which forms a double festoon downward.

The enamel of the molar teeth of *Archaeotherium* is everywhere corrugated, but this appearance wears off as age advances.

In the trituration to which the true molars are subjected, the enamel at the apices of the lobes is first worn through, and the exposed dentine afterwards extends across the latter in transverse tracts.

The posterior two premolars, in the specimen upon which the species was originally established, exhibit the result of considerable mastication. In the last premolar the posterior basal ridge is partially worn away, and the anterior portion of the same ridge and the division between the lobes are completely obliterated. The triturating surface in its present condition, presents a broad, transversely ellipsoidal

disk of dentine, communicating by means of a narrow isthmus with a smaller disk, of the same form as the former, at the base of the anterior margin of the outer lobe. In the penultimate premolar the apex of the crown is worn off, leaving a subcircular dentinal surface continuous with a narrow tract, extending the length of the posterior margin. (IX. 3, 4.)

The upper true molars of *Archaeotherium*, and the last premolar are inserted by three fangs; two external and nearly vertical, and a third internal, which is broad, and is apparently composed of two portions confluent. The penultimate premolar is implanted by two fangs, which are nearly vertical, and are placed one before the other.

Inferior Molars.—(VIII. 2; X. 2, 3.) Of the lower molar teeth of *Archaeotherium* we have the true molars and the last premolar; but we have no opportunity of comparing them with figures of the corresponding teeth of *Entelodon*.

The crowns of all the true molars possess the same form, and differ only by successively decreasing from behind. They are oblong oval, and constricted at the middle, and are composed of two transverse pairs of conical lobes, with wrinkled sides. Posteriorly they are bounded by a conical tubercular heel, which relatively is not better developed in the last of the series than in those in advance; and anteriorly below the confluence of the lobes they are embraced by a thin basal cingulum.

A remarkable peculiarity of a gêneric character in these teeth is a transverse division of the apex of the antero-internal conical lobe, apparently as if this was composed of a confluent pair.

The last permanent premolar is constructed upon the same plan as the penultimate premolar of the upper jaw. The crown is large, transversely compressed conoidal, and slightly curved backward, and is bounded anteriorly and posteriorly by a salient margin. At the base posteriorly a ridge exists with a festooned prolongation on each side, and antero-internally a smaller and excavated talon exists with an outer simple and inner double festoon.

The inferior true molars are inserted by two broad fangs placed one before the other, and consisting each of a connate pair; and the last premolar also has two fangs, but these are simple in their form.

Temporary Dentition.—(VIII. 1, 2; IX. 1.) As in the Hog, the anterior two permanent true molars are fully protruded before the deciduous molars are shed, from which fact, together with the evident suilline character of *Archaeotherium*, it is reasonable to suppose the order in succession of the permanent to the caducous dentition is the same as in the former animal.

The upper temporary true molar resembles the upper permanent true molars, but it is very oblique antero-internally, and all the lobes of the masticating surface except the two external are quite rudimentary. At the base of each outer lobe externally there exists a festooned ridge.

The penultimate deciduous tooth has an antero-posteriorly elongated, trihedral crown; the posterior half of which is the broader, and is composed of a transverse row of three lobes, as in the true molar behind it, except that the internal one is

as well developed as that external; and the anterior half forms a quadrilateral pyramid, more elevated than the lobes behind.

The deciduous true molar with its anterior portion broken away is contained in one of the fragments of a lower jaw, and is sufficiently perfect to show it keeps up the suilline character of the animal, in having an additional pair of conical lobes to the normal number of the permanent true molars.

The enamel of the deciduous teeth is thinner and less corrugated than that of the permanent teeth.

The species is named in honor of the late distinguished Dr. Samuel George Morton, of Philadelphia.

MEASUREMENTS.

(*Taken from the young specimen.*)

	Lines.	Inches.
Distance from meatus auditorius to the infra-orbital foramen	8	6
Distance from meatus auditorius to the lachrymal tubercle	5	9
Breadth of head at the transverse fronto-malar suture	7	0
Greatest breadth at lowest part of ossa malarum	8	9
Length from occipital condyles to anterior part of penultimate premolar	10	0
Distance inferiorly between the glenoid articulations	4	6
Greatest breadth inferiorly of the temporal fossæ	3	3
Greatest length inferiorly of the temporal fossæ	3	6
Narrowest part of inter-temporal region	2	3
Greatest breadth at squamous suture	2	9
Breadth at lachrymal tubercles	4	1
Breadth at posterior margin of infra-orbital foramina	2	8
Breadth of hard palate between the middle true molars	1	5

SUPERIOR MOLARS.

	Antero-posterior.	Transverse.
Diameter of seventh molar	9¾ lines.	9 lines.
Diameter of sixth molar	11¾ "	11½ "
Diameter of fifth molar	10 "	10 "
Diameter of fourth molar	9¾ "	9 "
Diameter of third molar	12½ "	7 "
Diameter of last temporary molar	10 "	8 "
Diameter of penultimate molar	11½ "	7½ post. 4 ant.

INFERIOR MOLARS.

Diameter of seventh molar	12 lines.	8 lines.
Diameter of sixth molar	12 "	8½ "
Diameter of fifth molar	10½ "	7½ "
Diameter of fourth molar	12¾ "	6 "

Archaeotherium (*Entelodon?*) **robustum**, Leidy.

(Plate X., Figs. 8–13.)

Arctodon, Leidy: Proc. Acad. Nat. Sci., 1851, v. 278.

Archaeotherium robustum, Leidy: Owen's Rep. of a Geol. Surv. of Wisc., etc., 572.

This species is proposed upon fragments of the crowns of the posterior two molars of the left side, and a portion of the crown of a canine tooth probably of the left side inferiorly.

These specimens, which belong to the collection obtained by Mr. T. A. Culbertson, I at first supposed indicated the existence of a genus allied to the Bear; but by comparison, they have since been determined to belong to a species of *Archaeotherium* larger than that described in the preceding pages.

The fragments of molars (X. 10–13) are almost identical in their form with the corresponding portion of the same teeth of *Archaeotherium Mortoni*, except that in the last molar the posterior basal ridge rises into a conical eminence or fifth lobe, which is more regular, but less prominent, and more expanded at the base than those in advance. The teeth have been almost a fourth larger than those corresponding of *Archaeotherium Mortoni*.

The fragment of the crown of a canine (8, 9) resembles more that of the Bear than that of any existing ungulates. It is curved conical in form, and presents a slight longitudinal ridge defining its outer and inner faces. It is completely covered with enamel, which is thinnest at the inner face, and is unworn in the specimen.

CHAPTER II.

DESCRIPTION OF UNGULATA IMPARIDIGATATA.

Fam. 1.—SOLIPEDIA.

Gen. **ANCHITHERIUM,** MEYER.

UNDER the name of *Palaeotherium aurelianense*, M. De Blainville has included also the *Palaeotherium monspessulanum*, and the *Palaeotherium equinum*, Lartet, seu *hippoides*, De Blainville.[1] These, according to the view of M. De Christol, (Comptes Rendus, vol. xxiv., p. 374,) do not belong to the genus *Palaeotherium*, but to a soliped, to which the name of *Hipparitherium* is given. In regard to this animal, he observes, "Ses os des membres ressemblent à un tel degré à ceux de l'Ane et du Cheval, qu'on en trouve une description très étendue et trés-rigoureuse dans les traités d'anatomie vétérinaire, et qu'on peut suivre sur ces os de pretendus Palaeotheriums les descriptions myologiques des vétérinaires aussi complétement et aussi sûrement que sur une squelette d'âne ou de cheval."

H. von Meyer had already placed this species in a new genus under the name of *Anchitherium Ezquerrae*,[2] which generic name is adopted by M. Pomel, in his classification of the *Palaeotheria*, as a subgenus.[3]

As a result of these investigations the specific name of the animal is *Anchitherium aurelianense*, Gervais.

A second species, the *Anchitherium Dumasii*,[4] has been indicated by Gervais from the eocene formations of France.

Anchitherium Bairdii, LEIDY.

(PLATE X., Figs. 14–21; XI.)

Palaeotherium Bairdii, Leidy: Proc. Acad. Nat. Sci., 1850, v. 121.
Anchitherium Bairdii, Leidy: Owen's Rep. of a Geol. Surv. of Wisc., etc., 572.

Among the fossil remains collected by Mr. Alexander Culbertson were the greater portion of a skull and fragments of jaws with teeth, of a species of *Anchitherium*. The teeth of this so closely resemble those represented in De Blainville's Osteographie, under the name of *Palaeotherium hippoides*, that they might readily

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[1] Osteographie: Palaeotherium, 75.
[2] Jahrbuch für Mineralogie, 1844, 298.
[3] Bul. Soc. Geol. de France, vii. 219.
[4] Comptes Rendus, xix., 381, 572.

be considered to belong to the same species, were it not that those of the Nebraska animal, which I have called *Anchitherium Bairdii*, are only about three-fifths the size of those of the former.

The specimens which we have an opportunity to study are as follows:—

1. The cranium proper, with a portion of the face containing on one side the last two and on the other the last three molars. The zygomata and post-orbital arches are broken away. The specimen was accompanied by several fragments of a lower jaw, of which two contain the last two molars, and one has the coronoid process nearly entire.

2. Both sides of the upper and lower jaws containing nearly all the molar teeth.

3. Three small fragments of lower jaws of different individuals, containing teeth.

The *Anchitherium Bairdii*, as indicated by the specimens, was rather more than half the size of the *Anchitherium aurelianense*.

Description of the Head.—The cranial specimen is particularly important from its being the first yet discovered of the genus *Anchitherium*. In its form it is remarkably like that of the corresponding portion of the skull of the Horse, and presents but few points of resemblance to the *Palæotherium*, to which genus it has been supposed to belong.

Lateral View.—(XI. 1.) The skull of *Anchitherium* appears relatively shorter than that of the Horse; as, in the specimen under examination, the molar teeth are much less advanced in their position than in the latter; the last of the series being placed below the middle of the orbit.

The upper outline of the cranium proper, as in the Horse, is convex, and the temporal fossa has the same form and relative convexity; and posteriorly it mounts in the same manner upon a low sagittal crest. The summit of the inion and the posterior boundary of the temporal fossa are relatively not quite so prominent as in the Horse, but as in this, the root of the zygomatic process is implanted about the middle of the lower border of the fossa.

The mastoid portion of the temporal bone is relatively higher than in the Horse; and, as in this, impressed upon the parietal bone, there ascends from the squamous suture a large, deep, irregular, branched, vascular channel.

The meatus auditorius is bounded below by a thick auditory process.

The face is relatively of less depth than in the Horse, arising from the shortness of the teeth, compared with those of the latter. Below the position of the orbit the alveolar margin is convex antero-posteriorly, as in the Horse.

The malar bone does not advance as much upon the face as in the latter; its anterior suture ascending obliquely from the position of the last molar to the anterior lachrymal suture.

In the specimen, the orbits, at their inferior margin are broken away. When perfect, their entrance appears to have had almost the same form as in the Horse, but was relatively very much larger. They are also more deeply excavated, and approached each other much more. Their floor is very extensive, and at its posterior part forms a thick, obtuse margin, which is situated considerably below the level of the sphenoidal bodies.

Whether a post-orbital arch existed cannot be ascertained from the specimen, for

in this the process of the os frontis, which, in the Horse, contributes to its formation, is broken away to its base, leaving a triangular surface, two sides of which measure only three lines, the other four lines.

The lachrymal bone externally is almost as concave as in the Sheep, leading us to suspect the existence of shallow larmiers. Its orbital margin is acute, and within this, at its lower part, there is a single, vertically oval, lachrymal foramen.

Superior View.—(XI. 2.) The upper view of the cranium of *Anchitherium* also resembles very much that of the Horse. The forehead is a little more flat, and extends into a relatively larger triangle posterior to the coronal suture, which holds a corresponding position. The anterior margin of the frontals are not extended into long angular processes between the bases of the ossa nasi, as in the Horse, but form together a very obtuse angle.

The sides of the face, as formed by the lachrymal bones and the upper maxillaries below them, descend much more abruptly from the anterior orbital processes of the ossa frontis, or they approach the vertical line much more nearly than in the Horse.

In the specimen, the sagittal suture of the frontals and parietals is still open.

Posterior View.—(X. 20.) The inion, from its summit being relatively less broad, is more triangular in outline than in the Horse. Its middle part bulges over the foramen magnum, and above this point is depressed upon each side of a slight vertical ridge.

The relative position and form of the condyles and the form of the foramen magnum are very much the same as in the Horse, except that the inferior surfaces of the former are more nearly horizontal, and diverge more posteriorly and approach nearer anteriorly.

Above each condyle, as in the Horse, there exists a crescentic depression of the occipital surface.

Inferior View.—(X. 21.) The basilar process is relatively broader, less deep, and more angular than in the Horse, and upon each side it presents a long impression, and at the middle is elevated into a superficial tuberosity for muscular attachment.

The junction of the basilar process with the sphenoidal body occupies the same position as in the Horse, being on a line with the anterior margin of the foramina lacera, but in the specimen it is obliterated.

The sphenoidal bodies are slightly convex compared with those of the Horse, and the posterior does not present the deep muscular impressions existing in that animal.

The paramastoids hold the same relative position to the condyles as in the Horse, and as in this between them a deep fossa exists, at the inner side of which the anterior condyloid foramen is situated.

The os tympanica is relatively slightly more dilated than in the Horse; and the os petrosa abuts closely against the basilar process.

The base of the styloid process, alone remaining in the specimen, is embraced antero-internally by the os tympanica.

The foramen lacerum is large anteriorly, but becomes a very fine crevice posteriorly.

The inner portion of the glenoid articulation, which alone is preserved in the specimen, resembles very much that corresponding to it in the Horse. The postglenoid tubercle is relatively much more robust; and is mammillary in its form.

The surface, for attachment of the external pterygoid muscle in advance internally of the glenoid articulation, is much less inclined than in the Horse; and at the antero-internal part, as in this, it presents a foramen conducting to the foramina rotundum and spheno-orbitale.

The latter, and the optic foramina, are of large size, and hold very nearly the same relative position as in the Horse.

The interpalatine notch, as in the latter, expands as it approaches its bottom, which is on a line with the interval of the fifth and sixth molar teeth.

The hard palate is broken in the specimen, but it appears to have been about as much arched as in the Horse, and the exit of the posterior palatine canals is just in advance of the sides of the interpalatine notch.

Inferior Maxilla.—(Pl. X., Figs. 18, 19; XI. 5, 6.) As in the case of the alveoli of upper jaw, corresponding with the shortness of the teeth relatively and comparatively with those of the Horse, the body of the lower jaw of *Anchitherium* is proportionately less deep than in the latter. Its outer side is vertical and slightly convex; its base is thick and slightly convex forward; and its upper margin rapidly ascends posteriorly, and curves in a sigmoid manner more backward to the summit of the coronoid process than in the Horse.

The coronoid process is curved like in ordinary ruminants, but is relatively shorter and broader.

The condyle is very like that of the Horse, but the notch in advance of it is relatively broader.

The ramus, which in the Horse is very slightly depressed externally below the position of the coronoid process, in the fossil is almost as much depressed as in the Peccary.

Dentition.—(Pl. X. 14–17, 21; XI. 1, 3–8.) Gervais[1] states the formula of the dentition of *Anchitherium* to be:—

$$in.\ \frac{3}{3}\ \frac{3}{3}\ can.\ \frac{1}{1}\ \frac{1}{1}\ mol.\ \frac{7}{7}\ \frac{7}{7}.$$

It is extraordinary that *Anchitherium* should be so much like *Palaeotherium* in the anatomical and physiological construction of its teeth, and yet be so much like the Horse in its skeleton.

The crowns of the molar teeth of *Anchitherium* are entirely devoid of cementum, and in the adult are completely exserted.

The specimens of *Anchitherium Bairdii*, which we have an opportunity of examining, contain in the upper and lower jaws all the molar teeth except the first of the series.

The posterior six upper molars (XI. 3, 4,) are nearly alike in form and size; the crowns, as in those of *Palaeotherium*, consisting of two transverse pairs of lobes.

The outer lobes, as in the genus just mentioned, are demiconoidal with triangular summits, the basal angles of which are continuous with the extremities of inverted U shaped ridges bounding the sides and bases of the external transversely concave surfaces.

The inner lobes are conoidal, and are prolonged outwardly to the antero-internal

[1] Zoolog. et Palæont. Franç., p. 63.

side of the outer lobes; in this course becoming dilated into a small conoidal process about the middle.

These teeth are not bounded by a basal ridge internally, but portions exist anteriorly and posteriorly; and in the latter position inclose a small conoidal process.

The first upper molar of the normal series is much smaller than the others, as is indicated in the specimens by two small fangs, one before the other.

The inferior molars (X. 14–17; XI. 5–8,) also are exceedingly like those of *Palæotherium*. Their crowns are composed of two lobes placed one before the other, except the last of the series, which has an additional, or third lobe. The lobes are demiconoidal, with their outer side angularly convex and their inner side concave and sloping. Their summit is V shaped; and the posterior extremity of this rises to the apex of a pyramidal process of the inner side of the crown. The anterior extremity of the summit of the anterior lobes curves to the base of the anterior pyramidal process, while that of the summit of the posterior lobe ceases upon the outer side of the same process. In the unworn teeth the apex of the anterior pyramidal process is indented. The third lobe of the last molar is smaller than those in advance, is ovoidal in form, and has a crescentic summit inclosing a concave fossa.

The inferior molars have no continuous basal ridge, but a portion exists between the bases of the lobes externally, in the form of a small pyramidal tubercle; at the anterior part of the crown; and at the posterior part of the latter, in which position it forms an angular process.

The first inferior molar, as indicated in the specimen by a single fang which it possesses, is a much smaller tooth than any of those in the series posterior to it.

The species is named in honor of Prof. S. F. Baird, of the Smithsonian Institution.

MEASUREMENTS.

	Inches.	Lines.
Length of cranium from summit of inion to anterior extremity of ossa frontis	4	8
Length from occipital condyle to anterior orbital margin	4	0
Length of temporal fossa	3	0
Length of sagittal crest	1	7
Length of ossa frontis	2	5
Height of inion	1	8
Height of face at last molar alveolus	2	2
Height of orbit from floor to supra-orbital margin	1	6
Breadth of cranium at para squamosæ	2	0
Breadth of forehead at anterior orbitar processes	1	10
Breadth at paramastoids	1	9
Breadth at post-glenoid tuberosities	2	4
Breadth of hard palate at sixth molares	1	0
Height of body of lower jaw at last molar	1	2
Height of body of lower jaw at second molar	0	7½
Length of upper normal series of molars	2	11
Length of lower normal series of molars	3	0
Antero-posterior diameter fourth upper molar	0	6
Transverse diameter fourth upper molar	0	7½
Antero-posterior diameter fourth lower molar	0	6
Transverse diameter fourth lower molar	0	4½
Antero-posterior diameter last lower molar	0	7

Fam. 2.—Imparidigitata Ordinaria.

TITANOTHERIUM, Leidy.

Titanotherium Proutii, Leidy.

(Plate XVI. XVII., Figs. 1–10.)

Palæotherium, Prout: Am. Journ. Sci. Arts, 1847, iii., 248, figs. 1, 2.
Palæotherium? Proutii, Owen, Norwood, and Evans: Proc. Acad. Nat. Sci., 1850, v., 66; Leidy: Ib., 122; Owen's Rep. of a Geol. Surv. of Wisc., etc., 551.
Rhinoceros Americanus? Leidy: Ib., 1852, vi., 2.

In the American Journal of Science and Arts for 1847, page 248, Dr. Hiram A. Prout, of St. Louis, described and figured the fragment of a lower jaw containing the true molars of a huge animal, supposed to be a species of *Palæotherium*.

The specimen, which was the first fossil from the eocene cemetery of Nebraska, presented to the notice of the world, with another corresponding of the opposite side, apparently from the same individual, were kindly loaned to me by Dr. Prout for examination. (Pl. XVI. Fig. 1.)

These strongly resemble the corresponding portion of the lower jaw of *Palæotherium*, and if they do not belong to this genus they do to one closely allied to it; and if the animal preserved the same relations of size as *Palæotherium magnum* it was more than twice the size of this, which Cuvier has estimated to have been over four and a half feet in height at the withers, or equal to the *Rhinoceros* of Java; less lofty than a large Horse, but stouter, with a more massive head, and with extremities thicker and shorter.

The two fragments of the lower jaw, before assuming their present mineralized condition, were very much fractured, and the fissures are now filled up by a hard matrix, which also adheres to their exterior surface in a concretionary form.

Along the true molar series the jaw measures eleven inches; below the middle lobe of the last molar it is six inches in depth; and midway below the position of the first true molar is nearly two and a half inches in thickness. The sides are slightly convex vertically, and the bone is thick and rounded, and descends from the position of the last molar towards the posterior broken margin of the specimen. Two inches back of the last molar the depth of the fragment is nine and a half inches, but its thickness is not so great as it is anteriorly.

The inferior true molars are constructed upon the pattern of those of *Palæotherium;* the anterior pair being composed of two, the last of three demiconoidal lobes. These have crescentic summits, the extremities of which rise to the inner side of the teeth, and there become confluent, and form prominent points. In the specimens under examination, the outer side of the lobes of the molars is embraced by a strong basal cingulum about two lines in depth. The inner surface of the teeth forms a vertical plane, which is slightly convex antero-posteriorly, and does not possess the slightest trace of a basal ridge such as exists in the true *Palæotherium*.

The triturating summits of the lobes present more or less broad crescentic surfaces of exposed dentine, bordered by enamel, with the horns rising to the inner side of the teeth, and there becoming confluent and forming simple conoidal prominences. The enamel spaces embraced by the horns of the crescentic summits of the lobes do not slope towards the base of the teeth internally, as is represented to be the case in the figures of the corresponding teeth of *Palæotherium*, but they form deltoidal concavities, which are nearly on the same level with the dentinal crescents, and are bounded internally by a thick obtuse border; open, however, at the middle to the bottom of the concavities.

The third lobe of the last molar is smaller than those in advance, and resembles one of them atrophied at its posterior half. The external basal ridge of this tooth ceases upon the third lobe just before reaching its posterior surface; but upon this internally a small portion is developed.

The enamel of the teeth is rugose, and is most so externally, in which position it also presents a very uniform series of transverse striæ. At the triturating surface of the teeth externally, where the enamel is thickest, it measures one line and two thirds.

The measurements of the teeth in the fragments of jaw just described, are as follows:—

	ANTERO-POSTERIOR.		TRANSVERSE.	
	Inches.	Lines.	Inches.	Lines.
Last molar	4	6	1	10
Second true molar	3	3	2	
First true molar	2	8	1	10

In the collection of Dr. Owen, there is preserved a portion of the left side of a lower jaw (Pl. XVI., Figs. 2, 3) containing true molars exactly like those just described, and the fangs of the preceding two premolars. Accompanying this specimen, and probably derived from the same individual skeleton, there are also the crown of the second or third left lower premolar, the crown of a lower canine, and fragments of two upper molars. The fragment of lower jaw, before it became infiltrated with mineral matter, was very much crushed, and at present it is more light and friable than any other of the specimens of fossils which have been brought from Nebraska. It is considerably smaller than the corresponding part of the bone in Dr. Prout's specimens, measuring nine and a half inches along the series of true molars, five and a quarter inches in depth below the last molar, and an inch and a quarter in thickness below the first true molar. Two inches posterior to the last molar it is seven and a quarter inches in depth. Its form closely corresponds with that of Dr. Prout's specimens, as does also the form of the teeth contained in it, except that their basal ridge is not of uniform depth, but gradually rises in a pyramidal manner, and becomes thinner from between the lobes to their most prominent external part.

The teeth are more worn than in the specimens of Dr. Prout, and their enamel presents the same appearance, but in the same position is a third of a line less in thickness.

The measurements of the true molars are as follows:—

	ANTERO-POSTERIOR.		TRANSVERSE.	
	Inches.	Lines.	Inches.	Lines.
Last true molar	4	2	1	11
Second true molar	2	9	1	9
First true molar			1	7

The isolated crown above mentioned of an inferior left premolar (Pl. XVI. Figs. 8–10), probably the second, measures only sixteen lines antero-posteriorly, and almost an inch transversely, indicating a rapid reduction in size of the teeth from behind forward; nevertheless, this is gradual, for the fangs of the last premolar, still retained in the portion of lower jaw, on a line with the connection to their crown, measure twenty-one lines antero-posteriorly. The inner side (Fig. 10) of the specimen of the premolar is a smooth vertical plane; and externally (Fig. 9) the basal ridge is deep, but thin, and rises to the most prominent part of the lobes, as upon the true molars. The masticating surface (Fig. 8) presents a broad tract of dentine bordered by enamel, bilobed externally, and straight internally.

The crown of the inferior canine (Pl. XVI., Figs. 11, 12) is curved conical in form, and, in section at its base, is very nearly circular. Internally, its base is embraced by a thick, deep cingulum, with a prominent margin, which exhibits also a tendency to pass around the outer side of the tooth. The outer (Fig. 11) and inner (Fig. 12) sides of the tooth are defined by a saliance of the surface, and the former is uniformly convex and smooth, the latter angularly convex, less broad, and less smooth. The enamel is worn off from the point of the tooth, and also below this antero-externally over an oval space almost half an inch in length, indicating that the inferior canine, as in the undoubted *Palaeotherium*,[1] occupies a position, when the mouth is closed, posterior to the superior canine.

Measurements of the crown of the inferior canine are as follows:—

	Inches.	Lines.
Circumference at base	3	
Length of external convex surface	1	7
Height from the base internally	1	2

Of the two fragments of upper molars above mentioned, one is the internal half of the crown of a premolar (Pl. XVII., Figs. 5, 6), probably the second; the other is an internal portion of a true molar (Pl. XVI., Figs. 6, 7).

The former specimen measures one inch five lines antero-posteriorly, and its masticating surface (Pl. XVII., Fig. 5), which is very much worn down, presents a form intermediate to that in the corresponding tooth of *Palaeotherium magnum*, and *Aceratherium incisivum*. Internally (Fig. 6), the crown is transversely convex, and is very sloping inwardly from the fangs, so that the tooth has projected very considerably internal to the alveolar margin of the palate. This side of the tooth is formed by a thick and deep cingulum, which envelops the bases of the inner lobes, and exhibits an obtusely rounded margin, thickest anteriorly.

The inner lobes, of which the anterior is very much larger than the posterior, are confluent, and, in the specimen, are nearly worn to their base, and present a

[1] Cuvier, Rech. sur les Ossem. Foss., éd. 3, III. 8, 9, Pl. V., Fig. 1.

tract of dentine (Fig. 5) extending to the broken margin of the tooth. The external portion of the dentinal surface about its centre, and near the posterior margin, is occupied by a pair of trilateral enamel islets, which are the remains of the terminations of transverse valleys, such as exist in the molars of *Rhinoceros* and *Palaeotherium*.

The fragment of a superior true molar (Pl. XVI., Figs. 6, 7) presents a large conical protuberance, corresponding to that antero-internal in the *Palaeotherium magnum*. It has the enamel of its apex just worn through, leaving a discoidal surface of dentine about one line in diameter. External to the conical lobe are remains of the abraded masticating surface of the outer lobes of the tooth, and at the base of the former, there exists one side (Fig. 7) of a deep pit homologous with that at the base of the posterior half of the inner face of the antero-external lobe of the corresponding tooth in *Palaeotherium magnum*. Antero-internally to the base of the conical lobe, a thick, obtuse prominence (Figs. 6, 7) exists, which is a portion of a basal ridge; but of this no trace exists on the inner side of the tooth, like that in *Palaeotherium magnum*.

In Dr. Owen's collection, there are also the isolated crowns of an inferior first and last true molar (Pl. XVII., Figs. 8–10), apparently from two other distinct individuals of the same species as that indicated by the specimens just described.

The measurements of these are as follows:—

	Inches.	Lines.
Antero-posterior diameter of the last inferior molar	4	3
Transverse diameter of the last inferior molar	1	7
Antero-posterior diameter of the first true molar	2	10
Transverse diameter of the first true molar	1	10

In the collection of Dr. Prout, and accompanying the two portions of a lower jaw, which have been the subject of investigation, is a portion of the left superior posterior molar, probably belonging to the same species, though not to the same individual (Pl. XVI., Figs. 4, 5). What is preserved of this specimen exhibits a strong resemblance to the corresponding part of the homologous tooth in *Palaeotherium magnum;* but it presents several important differences.

Upon the masticating surface of the crown, the valleys everywhere, antero-posteriorly as well as transversely, are nearly uniform in depth (Fig. 5).

The summits of the outer lobes have been denuded of their enamel, and present the remains of a broad W shaped tract of dentine, while the apex of the antero-internal mammillary lobe has not yet had its enamel worn through.

As in *Palaeotherium magnum*, at the base of the posterior half of the inner face of the antero-external lobe, there is a deep elliptical pit of enamel, and a little posterior to this is a second smaller and shallower pit.

The external face of the crown of the superior molars of *Palaeotherium*, as described by Cuvier, inclines inward as it descends, and is divided by three longitudinal salient ridges (*arretes*) into two concavities, rounded towards the fang, and terminating in a triangular cusp at the triturating surface, the basal angles of which rest upon the salient ridges.

In the special subject under investigation, about three-fourths only of the outer

surface of the antero-external lobe (Fig. 4) is preserved, and this does not conform to the characteristic appearance of the corresponding portion of the tooth of *Palaeotherium*. It inclines and terminates below as in the latter, but relatively is only slightly concave, and it possesses no bounding salient ridge at its anterior part, such as is represented in the figures of the teeth of *Palaeotherium* in the works of Cuvier, Jaeger, De Blainville, Gervais, and others. In the place of such a ridge, the tooth forms a prominent convex margin, projecting, as in ruminants, in *Rhinoceros* and *Palaeotherium* itself, exterior to the position occupied by anterior molars, and the basal ridge winds around the prominent margin to the anterior part of the tooth, descending to its masticating surface, which it reaches, in the specimen, a half inch internal to the outer edge of the latter.

The dimensions of the tooth, so far as they can be ascertained in its present condition, are as follows:—

	Inches.	Lines.
Distance from the apex of the antero-internal lobe to that externally of the antero-external lobe	1	6
Height of latter from base to point.	2	2

The enamel of the specimen just described is smooth upon the masticating surface, and at the base of the antero-internal conical lobe is about one line in thickness. On the outer side of the antero-external lobe it is rugose, and at the external masticating margin of this is also about one line in thickness. In other positions it is thinner, especially where it invests the inner sides of the outer lobes, the bottom of the antero-posterior valley, and the deep pits.

The various fragments of lower jaw and teeth above described, though exhibiting a very great resemblance to the corresponding parts of the *Palaeotherium magnum*, are yet sufficiently different to indicate they probably belong to a distinct but closely allied genus, for which the provisional name of *Titanotherium* is proposed. The most important differences, which have been presented, are the absence of a basal ride at the inner side of the inferior molars, and at the same side of the fragment of a superior true molar; the nearly uniform depth of the antero-posterior and transverse valleys in the upper true molars; and the absence of the salient ridge, characteristic of *Palaeotherium*, at the anterior margin of the antero-external lobe of the last superior molar.

In the collection of Mr. Thaddeus A. Culbertson, there are the crowns, nearly whole, of two superior premolars (Pl. XVII., Figs. 1–4), and fragments of two others, which also probably belong to *Titanotherium Proutii*. These, I stated in a verbal communication to the Academy of Natural Sciences, probably belonged to a species of *Rhinoceros*, for which the name *R. Americanus* was proposed,[1] but they certainly do not belong to this genus, though closely partaking in its characters those of *Palaeotherium*.

The nearly perfect crowns of the superior premolars are quadrate, and are greater in their transverse diameter than antero-posteriorly. Their outer side

[1] Proc. Acad. Nat. Sci., VI., 2.

(XVII. 2) presents a basal ridge, descending at its anterior and posterior margin to the masticating surface; but it does not possess a median salient ridge like that of *Palæotherium*, nor does it present the anterior characteristic fold of the *Rhinoceros*. The portion of this surface corresponding to the posterior lobe inclines inward, in its course downward, and the anterior portion of the same surface rises into a median longitudinal prominence, descending to the apex of the anterior lobe.

The inner side (1) of the teeth is transversely convex, and forms a thick and deep cingulum, with a wide, obtusely rounded border, enveloping the bases of the inner lobes.

The latter, of which that anterior is very much the larger, are confluent their entire height, and are isolated from the outer lobes nearly to their base; thus destroying the principal transverse valley as it usually exists in the molars of *Rhinoceros* and *Palæotherium*, and creating one antero-posteriorly (3, 4).

The antero-posterior valley, at the position corresponding to the depressed interval of the outer lobes, communicates with a large and deep trilateral pit, homologous with the termination of the principal transverse valley in the molar teeth of *Rhinoceros*, and with a similar pit in the teeth of *Palæotherium*. Posteriorly this valley is connected with another, but smaller and shallower pit, which also finds its homologue in the *Rhinoceros* and *Palæotherium*. In one of the specimens (4), probably the third premolar, the antero-internal lobe is more confluent with the corresponding outer lobe than in the other; and its internal cingulum is more irregular.

In the trituration to which these teeth have been subjected, the enamel has been worn off from the masticating surface of the outer lobes, very nearly to the base of those within, leaving a broad tract of exposed dentine, which is bilobed internally by the deep central enamel pit. In the supposed third premolar (4), this tract is continuous, anteriorly upon the summit of the antero-internal lobe, but in the fourth premolar, the summits of the inner lobes present a separate antero-posterior tract.

The enamel of these teeth, except where worn, is slightly rugose, and, upon the outer lobes, externally exhibits numerous transverse undulating lines. It is thickest upon the inner lobes, where it is one line and a half; and upon the external part of the outer lobes it is about one line in thickness.

The measurements of the two specimens, in their present condition, are as follows:—

	Inches.	Lines.
Antero-posterior diameter of third premolar	2	5
Transverse diameter of third premolar	1	10
Antero-posterior diameter of fourth premolar	2	7
Transverse diameter of fourth premolar	1	9

One of the fragments of the premolars above mentioned, exhibits the inner lobes entirely associated as one, and disconnected to their base from the outer lobes. This connate lobe has the form resulting from the confluence of an anterior larger cone, with another posterior and smaller (7). The sides of the connate lobe, where not affected by attrition, are rugose, and the summit presents a clavate tract of dentine with a border of enamel nearly one line and a half in thickness.

The antero-posterior diameter of the tooth to which this fragment belonged, is one inch ten and a half lines. The specimen still retains a portion of the internal basal cingulum, extending anteriorly and posteriorly, and also portions of the two enamel pits with the intervening antero-posterior valley of the tooth.

The other fragment of a premolar, alluded to, consists of the fangs and a portion of the outer lobes, which exhibits the same peculiarities as those already described.

Dr. Evans states, in the report of Dr. Owen, previously quoted, that the remains of the *Palaeotherium* (*Titanotherium*) *Proutii* were found in a green, argillo-calcareous, indurated stratum, situated within ten feet of the base of the geological section. (See page 13 of this memoir.) He observes: "A jaw of this species was found, measuring, as it lay in its matrix, five feet along the range of the teeth, but in such a friable condition that only a portion of it could be dislodged; and this, notwithstanding all the precautions used in packing and transportation, fell to pieces."

"A nearly entire skeleton of the same animal was discovered in a similar position, which measured, as it lay imbedded, eighteen feet in length, and nine feet in height."

The specific name applied to the animal whose remains have just been described, was proposed in a letter to the Academy of Natural Sciences, of Philadelphia, by Drs. Owen, Norwood, and Evans, in honor of Dr. Hiram A. Prout, of St. Louis, who first indicated its existence.

PALAEOTHERIUM, Cuvier.

Palaeotherium giganteum, Leidy.

(Plate XVII., Figs. 11–13.)

In the collections of Messrs. Culbertson and Dr. Owen, there are several fragments of molar teeth of an animal equally huge with the *Titanotherium*, and most probably belonging to a species of *Palaeotherium*, which was twice the size of the *Palaeotherium magnum*.

The fragments, of which there are five, are only single external lobes of the upper molars. These, externally, correspond to the description of Cuvier of the teeth of *Palaeotherium*. A conjoined pair of the lobes forming the outer part of a tooth, "present the external face strongly inclined inwards in descending, and divided by three salient ridges into two concavities, which are rounded towards the fangs, and terminate in a triangular cusp at the masticating surface, the basal angles of which rest upon the termination of the salient ridges." The median ridge is a thick obtuse fold outwards of the tooth, and the anterior and posterior ridges are acute, roughened offsets from the basal ridge, descending to the masticating surface.

The measurements of the more perfect specimens are as follows:—

	Inches.	Lines.
Length of the longest lobe	2	4
Length of a second specimen	2	0
Breadth of the second specimen at the basal angles of the cusp	1	8
Length of the shortest lobe	1	7
Breadth of the shortest lobe at the basal angles of the cusp	1	3

RHINOCEROS, Linnaeus.

The existing species of *Rhinoceros* are confined to Africa and Asia, and the Islands of Java and Sumatra. A vast quantity of remains of extinct species have been discovered in Great Britain, the continent of Europe, Siberia, and the Himalayas, but, until the region of Nebraska had been visited, no traces of the genus had been found in America.[1]

The number of extinct species which have been proposed, frequently upon the slightest characters, is so great, that the criticism of De Blainville upon their authors appears to be quite just: "Qui semblent considérer les os comme des individus, comme des masses minérales, sans considérations biologiques ou physiologiques; en sorte que les espèces se créent chez eux, pour ainsi dire, au compas."[2]

Among the fossil remains discovered at Nebraska, are those of two species of *Rhinoceros*, certainly different from any of those found in other parts of the globe. The larger of the two species, as indicated by an almost entire skull, was nearly three-fourths the size of the *Rhinoceros indicus*, or it was about the size of the *Rhinoceros minutus*, Cuvier, which is regarded by De Blainville as a small variety of the *Rhinoceros incisivus*. The other was less than two-thirds the size of the former species, and is therefore the smallest *Rhinoceros* which has ever yet been indicated.

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[1] In the Monthly American Journal of Geology, etc., 1831, p. 10, the editor, G. W. Featherstonhaugh, has given a description of what he considered to be the fragment of a jaw, containing two incisor teeth of an animal closely allied to the *Rhinoceros*, found in Pennsylvania. Mr. Featherstonhaugh observes: "The mineral composition of this fragment gives it a very anomalous character, and is a circumstance entitled to the particular consideration of geologists. There is nothing of the nature of bone about it, except its form; the whole substance, the teeth included, being constituted of an aggregate of quartzose particles, and presenting the appearance, not of a gradual substitution by mineral infiltration to osseous matter, but of a cast of part of a jaw and teeth formed of small quartzose grit, and giving a semi-translucency to the teeth, which is wanting to the more opaque jaw."

Dr. Harlan, in his Medical and Physical Researches, refers to this specimen, page 268, and says: "For ourselves, we are disposed to wait for further discoveries of this nature, previous to admitting the present specimen as part of our fossil fauna. The specimen is no less singular or interesting to geologists, as demonstrating the very close analogy of a mere *lusus naturæ* of the mineral kingdom, if it be nothing else, to a portion of the animal skeleton." Dr. Harlan further remarks, in a note: "The original specimen was sent to London, and the geologists who there examined it, considered it of too doubtful a character to be admitted as a fossil remnant."

De Blainville, in his Osteographie, page 172, in reference to this specimen, says: "Ce n'est pas le lieu de discuter ce point au moins fort contestable; mais comme la pièce en nature fait aujourd'hui partie des collections du Muséum, nous pouvons assurer qu'elle ne resemble pas le moins du monde à un fragment de mâchoire de Rhinocéros, ni pour le corps de l'os, ni pour les dents prétendues. C'est sans doute une pièce artificielle, une grossière supercherie. Il est donc véritablement à regretter qu' on en ait hasardé et exprimé la pensée; et que tous les catalogues de paléontologie aient inscrit une espèce de Rhinocéros fossile en Amérique, sans même une expression de doute."

In addition, my friends Dr. I. Hays, and Mr. I. Lea, have informed me they had seen the specimen, and had always regarded it as a mere mineral fragment.

[2] Osteog. Gen., Rhinoceros, 212.

I was at one time disposed to consider the two species of Nebraska *Rhinoceros* as having belonged to the subgenus *Aceratherium*, Kaup, from the fact that in one of the specimens, upon which the larger species was established, the upper part of the face, as far forward as the position of the second molar tooth, presents no indication of an advancing rise to produce a prominence or boss at the end of the nose for the support of a horn. In the specimens of the smaller species, the face is too much mutilated to obtain any idea of its form, but from the resemblance of the back part of the cranium and the lower part of the face to those of the larger species, I supposed the similarity probably continued in the remainder of the face, and thus indicated the species to be of the same subgenus as the other. Upon more mature reflection, I am inclined to think both species of *Rhinoceros* of Nebraska possessed a horn upon the end of the nose, for although this portion of the face is not preserved in any specimens to determine the fact, yet the construction of the remaining portion of the face is more after the type of that of the true *Rhinoceros* than that of the *Aceratherium*. In this, according to the representation by Kaup (Fig. 2, Tab. X. of the Ossem. Foss.), the lateral notch of the anterior nares extends as far back as the commencement of the fifth molar tooth; or, as represented by De Blainville (Ost. Gen., Rhin., Pl. IX.), (who regards the *Aceratherium incisivum* as the female of the *Rhinoceros incisivus*, Cuvier, with which the name is synonymous), as far as the fourth molar tooth, thus leaving little width to the face from this point to the orbit, and a feeble support to the nasal bones from the ossa maxillaria, necessary to afford a firm basis to a nasal horn. On the contrary, in both species of Nebraska *Rhinoceros*, the lateral notch of the nares does not extend beyond the position of the first molar tooth, thus producing a great degree of relative breadth to the face, and an ample support laterally to the nasal bones, so as to enable them to sustain the horn, which probably tipped the nose. Both species of Nebraska *Rhinoceros*, at most, were unicorn, for the forehead is slightly depressed and smooth, and presents neither boss, elevated roughness, nor other indication of the existence of a frontal horn.

In the form of the upper molar teeth, the species of Nebraska *Rhinoceros* resemble the *Aceratherium incisivum* more than they do recent species of *Rhinoceros*, especially in the existence of a well-developed basal ridge on the inner side of the premolars.

In the smaller species of Nebraska *Rhinoceros*, incisor teeth existed in both jaws in the adult, as indicated in two specimens by small remaining fragments of the fangs, and it is probable that they also existed, under the same circumstances, in the larger species, although this is proved only for the upper jaw, one of the specimens of which yet preserves a portion of an incisive alveolus in the intermaxillary bone.

Rhinoceros Occidentalis, Leidy.

(Plates XII., XIII.)

Rhinoceros occidentalis, Leidy: Proc. Acad. Nat. Sci., 1850, v., 119; Ib. 1851, 276; Owen's Rep. of a Geol. Surv. of Wisc., etc., 552.
Aceratherium, Leidy: Proc. Acad. Nat. Sci., 1851, v., 331.

The materials which we have in possession to describe the larger species of *Rhinoceros* from Nebraska, are as follows:—

1. A skull, with the right superficial portion and end of the nose broken away, and otherwise much fractured and mutilated. It contains upon the left side all the molar teeth except the first, which fortunately exists upon the other side; but all the remainder are broken. From the collection of Dr. D. D. Owen.

2. Two fragments of lower jaws, from two other individuals; one containing the last two molars, the other the posterior three molars, except the last. From Dr. Owen's collection.

3. Nine fragments of as many upper molars, and eight small fragments of lower jaws, only two of which contain perfect teeth; apparently from three or four different individuals. From the collections of Messrs. Culbertson and Capt. Van Vliet.

The species was originally established upon several small fragments of molar teeth, procured by Mr. A. Culbertson, and its existence was afterwards confirmed by several entire molars brought home by Mr. T. A. Culbertson.

Description of the Skull.—The skull in the collection of Dr. Owen, is about three-fourths the size of that of the *Rhinoceros indicus*. Its upper part and left side, with the corresponding molar teeth, are comparatively well preserved. The specimen is an adult one, though it did not belong to an old individual, for all the molars are protruded, but in none is the enamelled triturating surface obliterated.

Lateral View.—(Pl. XII. Fig. 2.) One of the most remarkable features of the species is presented in the side view of the skull, viz.: the verticality of the inion, with the slight degree of inclination forward of the upper part of the head. Indeed, the latter is so nearly horizontal, that, in comparison with the skull of *Rhinoceros indicus*, it appears as if the two extremities of the head had been depressed, or, in other words, as if the head had been forcibly made straight. In connection with the peculiarity just described, a relatively large proportion of the temporal fossa is situated posteriorly to the root of the zygomatic process, which holds a position about the middle of the fossa, whereas in *Rhinoceros indicus* it is placed at the posterior third of the latter.

The zygomatic process extends from its root less outwardly, but rises more than in *Rhinoceros indicus*. Its upper margin slopes forward more than in the latter, and the upper surface of its root is nearly horizontal. The outer surface is vertical and convex; but anteriorly, or where the malar bone contributes to the formation of the zygoma, it is flat. The deepest part of the zygoma is just in advance of the glenoid articulation, and measures about two inches.

The meatus auditorius is vertically ovate, with the narrow part downward.

The temporal fossa has almost the same relative extent as in *Rhinoceros indicus*,

but it is longer, and less deep vertically. Superiorly, it is bounded by an acute ridge, diverging from the median line to the post-orbitar process. The parietal crest formed by the contiguity of this ridge of each side is broad and strong, and includes a median angular groove.

From the temporal surface, inclining to the middle line of the cranium, it appears more oblique than that of *Rhinoceros indicus*, but for two inches and a half above the zygomatic root it is nearly vertically convex. In advance of the root of the zygomatic process, the temporal fossa appears more deeply excavated than in the last mentioned species; and anteriorly it is better defined from the orbital cavity by a prominent pyramidal ridge, which proceeds in a curved line inward and backward from the post-orbital process to the position of the spheno-orbital foramen.

The side of the face from the post-orbital process forward is vertical. The orbit is excavated more transversely and deeply than in *Rhinoceros indicus*, and its orifice is better defined. The entrance constitutes three-fourths of a circle, and is bounded above by a very prominent supra-orbitar process, which is formed by the confluence of the antero- and post-orbitar processes. The surface of the supra-orbitar process is convex and rough, and its lower margin slightly overhangs the inferior edge of the orbit. The vertical diameter of the entrance of the orbit is two inches and a quarter; and it is defined below by a small pyramidal process at the junction of the malar bone with the zygomatic process of the temporal. The floor of the orbit is deeply concave, and terminates posteriorly by an abrupt convex margin. The lachrymal bone and foramen are too much broken to judge accurately of their form, but there appears to have been a single one of the latter, relatively of large size. The lachrymal process was small and rough. The face in advance of the orbit is much fractured in the specimen. It is relatively longer than in *Rhinoceros indicus*, and is quite vertical the entire extent. The greater portion of the infra-orbitar foramen is broken away, but sufficient remains to show its position to be about one inch and a half above the interval of the second and third molar. From a fragment of the left intermaxillary bone being preserved, it may be determined that the notch of the anterior nares was relatively short, compared with that of *Rhinoceros indicus;* and this bone is stronger, and is articulated by a finer serrated suture. It rises much more than in *Rhinoceros indicus*, its postero-superior extremity being even above the middle line of the face, or it is on a line with the inferior suture of the lachrymal bone, which is above the inferior margin of the orbit. The maxillo-intermaxillary suture is only a half an inch below the anterior portion of the naso-maxillary suture.

The intermaxillary fragment retains the bottom of the corresponding incisive alveolus, and this is just twenty-two lines from the posterior extremity of the bone in which it is situated, or is one inch and a quarter from the upper portion of the maxillo-intermaxillary suture, and presents some idea of the relative position of the incisive teeth compared with those of *Rhinoceros indicus*. So far as can be ascertained, the hiatus in advance of the molars to the intermaxillary bone has been about one inch and a half.

Superior View.—(Pl. XIII. 1.) The upper view of the head presents an extensive, depressed, trapezoidal surface. Commencing posteriorly as an angular groove, in-

cluded by the two ridges forming the parietal crest, it gradually expands forward, and, between the supra-orbitar processes, measures in its perfect state seven inches in breadth. On each side of the forehead above the anterior part of the orbits, and extending a short distance upon the nose, it is prominent and convex; but in the middle of the forehead, and upon the nasal bones, which incline slightly at their upper surface towards each other, it is transversely concave. Upon the forehead, in the specimen, are three slight exostoses.

The fronto-nasal suture is doubly crescentic with the conjoined horns directed forward. The lateral margins of the ossa nasi converge anteriorly, and are a little concave, but vertically are convex, and the naso-maxillary suture has been about three inches and a half in length.

Posterior View.—In examining the head from behind, the remarkable degree of lateral compression of the cranium in comparison with that of the *Rhinoceros indicus* is a striking feature of the species. The inion is exceedingly narrow in comparison with that of other species of *Rhinoceros*, and the occiput, in a corresponding degree, bulges out posteriorly, so that, in the median line, it projects at least an inch back of the position of the condyles.

In a corresponding degree with the narrowness of the cranium this is elongated, so that neither its capacity nor its surfaces for muscular attachment are less than in existing species of *Rhinoceros*.

In the specimen, the occipital foramen and condyles are too much broken to judge accurately of their form. The former appears to have been vertically oval, and not so much notched above as in *Rhinoceros indicus;* and it measured about one inch and a half in its long diameter, and one and a fifth in breadth. The condyles appear not to have differed in form from those of recent species of the same genus.

Inferior View.—(Pl. XII. 1.) The base of the skull is more nearly horizontal than in recent species of *Rhinoceros*.

A portion of one condyle, preserved in the specimen, indicates the position of the condyles to be more vertical than in *Rhinoceros indicus*. The angle of their articular surface is also more abrupt, is lateral, and nearly vertical. The posterior portion of the articular surface is directed backward and relatively slightly upward; the inferior portion forward and outward, or much less downward than in *Rhinoceros indicus*.

The basilar process in advance of the condyles is narrow, measuring a little over an inch only between the anterior condyloid foramina. It is elevated in the median line into a prominent acute crest, which is pyramidal posteriorly, and serves as a sort of abutment to the inferior termination of the condyles, and anteriorly it gradually decreases and vanishes at the prominent junction of the process with the post-sphenoidal body. The sides of the basilar process are concave antero-posteriorly, and form, between the condyle and the para-mastoid process, a deep concavity, at the anterior part of the bottom of which the condyloid foramen is situated.

The para-mastoid processes are broken in the specimen, and they appear to have been relatively small in comparison with those of *Rhinoceros indicus;* projecting, as they do, very little below the mastoid processes, which are much more robust in their proportions.

The foramen lacerum is relatively small compared with that of *Rhinoceros indicus*, and the foramen ovale, which is distinct from it, is situated on a line internally with the glenoid articulation.

The latter antero-posteriorly in comparison with its breadth, is relatively greater than in *Rhinoceros indicus*, and is directed more outwardly, and at its postero-external portion is more depressed.

The post-glenoidal tubercle is relatively short, thin, and broad compared with that of *Rhinoceros indicus*. It is obliquely compressed, and has one broad surface directed backward and inward; the other, forming part of the articulation, presenting outward and forward.

As in *Rhinoceros indicus*, the root externally of the pterygoid processes, is traversed by a short but large canal, into which opens a foramen representing the associated foramina rotundum and spheno-orbitale.

The passage to the posterior nares, between the pterygoid processes and vertical plates of the palate bones, has about the same relative extent as in *Rhinoceros indicus*.

The hard palate in the specimen is very much fractured, but the parts appear to have retained their natural relative position; and it is remarkable for its deep and narrow arched form. The molar teeth, in a nearly straight line upon each side, converge anteriorly, and are distant between the first premolars only nine lines, and between the anterior lobes of the seventh molars twenty-two lines. The inner sides of the molars, in advance of the posterior two, project internally beyond the alveolar margin, and gradually increase in this disposition to the first premolars, so that the passage between these latter and the hard palate forms nearly four-fifths of a cylinder.

Inferior Maxilla.—(Pl. XIII. 2–4.) Of the two fragments of the lower jaw preserved in Dr. Owen's collection, which are both of the left side of two different adult individuals, the one contains the last two molars and half of that in advance, and the other contains the third to the fifth inclusive. The depth of the lower jaw below the posterior molar is twenty-eight lines, and its thickness fourteen lines.

Superior Molars.—(Pl. XII.) The superior molars are about three-fourths the size of those of *Rhinoceros indicus*, and present a very great degree of resemblance to those of *Aceratherium incisivum*. All possess a basal cingulum, which, however, is feebly developed at the outer side of the antero-external lobe, and is entirely obsolete at the base postero-internally of the fifth and sixth molars, and for a narrow space internally upon the antero-internal lobes of the same pair of teeth. Upon the inner side of the base of the molars, from the second to the fourth inclusive, it is better developed than in the same position in *Aceratherium incisivum*.

In the seventh molar, the lobes are quite simple, neither of those within sending any sublobes into the single valley of the tooth, although they are very feebly bulging about the middle of their course.

In the corresponding lobes of the two molars in advance, the bulging of that anterior successively increases, while that posterior in the same position is constricted. This bulging of the lobes diminishes the depth of the principal valleys to a degree corresponding to its successive increase forward.

The bottom of the single, simple valley of the last molar is nearly level its whole length, and is bounded at its entrance by a prominent portion of the basal cingulum.

The principal valleys of the sixth and fifth molars are successively shallower externally, and deepen in a sloping manner toward their entrance, where they are partially closed by a prominent portion of the basal ridge, and hence, in the trituration to which the teeth are subjected, these valleys are obliterated from without inward, and leave no isolated enamel islands, or pits, as in the molars in advance, or in the corresponding teeth of *Rhinoceros indicus*.

In the sixth molar, the posterior valley is as deep externally as the principal valley, and in the fifth molar it is deeper.

In the specimen under consideration, trituration has left the principal valley of the fifth molar as a tract of enamel, which is narrow and slightly depressed externally and curves backward and inward, and expands and deepens as it approaches its termination.

In the second to the fourth molar inclusive, the inner lobes at their bases internally are confluent, and from the degree of trituration which the third and fourth molars have undergone in the specimen, the principal valleys are left as simple, oblique, trilateral pits or islets of enamel, occupying the centre of the exposed dentinal surface. In the second molar, from the less degree of confluence of the inner lobes internally, in addition to its being less worn, the principal valley still remains open.

In the fourth molar, the postero-internal lobe is not much more than half the thickness of that in advance ; but in the second and third molars, the inner lobes are nearly equal in size.

The basal cingulum of the molars, from the second to the fourth inclusive, envelops the base of the postero-internal lobes to a much greater extent than upon the antero-internal lobes, or rather these are shorter than the former, and the basal ridge descends in its course postero-internally, where it is very thick and strong, and is so prominent, that when the teeth are worn down so that the principal valleys remain only at their outer extremity as very small pits, the posterior valleys, which are very nearly as deep, would be left in the same condition.

The first molar in the specimen presents an almost equi-trilateral surface of exposed dentine, with the internal lobes of the crown curving inward and backward and dilating at their termination, and with the antero-external lobe forming its anterior rounded and prominent apex. Portions of a basal ridge connect the bases of the inner and the antero-external lobes together. The short principal valley remains as a narrow tract of enamel constricted at the middle and deepened at both extremities. The posterior valley remains as a small trilateral islet of enamel. Between the antero-external and internal lobes the basal ridge forms a broad cul-de-sac.

Inferior Molars.—(Pl. XIII. 2–6.) The teeth, preserved in the fragments of lower jaws referred to, belong all to the posterior four molars, and these do not differ in their form from those corresponding to them in recent species of *Rhinoceros*. A basal ridge with a rough margin exists in all, but is obsolete on the inner side of the

posterior three molars, and on the outer side of the posterior lobe of the same teeth, except the last. Between the bases of the lobes externally it forms a small tubercle.

Other Teeth.—No incisors are preserved in any of the specimens, but from a portion of alveolus preserved in one of the latter, already referred to, it is of course conclusive that incisors existed in the adult, at least in the upper jaw.

MEASUREMENTS OF THE HEAD AND TEETH.

	Lines.	Inches.
Length of skull from the upper margin of the occipital foramen to the inter-maxillary bone	16	9
Length of skull from same position to the first molar	15	4
Breadth of inion at the mastoid processes; estimated	5	0
Greatest breadth at the zygomata	8	0
From the tip of one post-glenoid tubercle to the other; estimated	3	6
Distance from the meatus auditorius externus to the lachrymal tubercle	8	0
Height of face from alveolar margin on a line with the anterior orbital margin	5	6
Height of face from alveolar margin on a line with the infra-orbitar foramen	4	6
Greatest breadth of forehead at the supra-orbitar processes	7	0
Length of upper molar series	7	3
Greatest breadth of seventh molar	1	7
Greatest breadth of sixth molar	1	8
Greatest breadth of fifth molar	1	7
Greatest breadth of fourth molar	1	6
Greatest breadth of third molar	1	4
Greatest breadth of second molar	1	0
Greatest breadth of first molar	0	9
Antero-posterior diameter of last lower molar	1	6
Antero-posterior diameter of the third lower molar	1	1

Rhinoceros Nebrascensis, Leidy.

(Plate XIV., XV.)

Rhinoceros Nebrascensis, Leidy: Proc. Acad. Nat. Sci., 1850, v., 121; Owen's Rep. of a Geol. Surv. of Wisc., etc., 556.

Aceratherium Nebrascensis, Leidy: Proc. Acad. Nat. Sci., 1851, v., 331.

Of the smaller *Rhinoceros* of Nebraska we possess portions of at least twelve different individuals, as follows:—

1. The anterior portion of a skull, accompanied by the lower jaw, of an adult individual. The former has the forehead, orbital entrance, and molar teeth well preserved, but the face is very much broken, and its nasal part is displaced. The lower jaw contains all the molars in perfect condition, but it has lost its rami and the symphysis. (XIV. 1–3.) From Captain Stewart Van Vliet's collection.

2. A much mutilated face, containing on both sides the molar teeth nearly perfect. It belonged to a nearly adult individual, as the teeth, which belong to the permanent series, are all in place except the last, which has about two-thirds protruded. (XIV. 13.) From the collection of Dr. Owen.

3. The skull, accompanied by a small fragment of the lower jaw, of a very old individual. The former has its upper part broken away, but the base is nearly

entire; and it contains all the molar teeth, which have their crowns worn nearly to a level with the alveolar margin. (XV. 1, 2.) From Dr. Owen's collection.

4. The crowns of four permanent premolars of the left side of the upper jaw and one of the right side. These are perfect and are not at all worn, having been concealed within the maxillary bones, from which they were removed with much labor. (XIV. 4–8.) Presented to the Academy of Natural Sciences, by Mr. Alexander Culbertson.

5. A small fragment of an upper jaw containing the first permanent true molar, slightly worn, and a portion of the fourth permanent premolar, which was still concealed within the bone. From Dr. Owen's collection.

6. A small fragment of an upper jaw, with an unworn sixth molar, and the seventh unprotruded. From Mr. Culbertson's collection.

7. A second inferior permanent molar, and two fragments of lower jaws. One of the latter contains the fifth molar unworn, and the other contains a sixth molar partially protruded. All three specimens are apparently from different individuals. From Mr. Culbertson's collection.

8. A fragment of the right side of a lower jaw, containing the last three molars. From Dr. Owen's collection.

9. A fragment of the left side of a lower jaw of a very young animal, containing the last temporary molar unworn, and the first permanent true molar protruded. (XIV. 9, 10.) From Dr. Owen's collection.

10. A fragment of the right side of the upper jaw, containing the posterior three temporary molars, which are considerably worn. (XIV. 14.) From Mr. Culbertson's collection.

Description of the Head.—The skull of *Rhinoceros Nebrascensis* is about three-fourths the size of that of *Rhinoceros occidentalis.*

Lateral View.—(Pl. XIV. 1; XV. 1.) So far as can be ascertained from the imperfect specimens, the side of the head presents most of the characters of that of *Rhinoceros occidentalis.*

The root of the zygomatic process is implanted about the middle of the bottom of the temporal fossa, and its upper surface is antero-posteriorly convex.

The temporal surface is convex and smooth, and, as in *Rhinoceros occidentalis,* apparently rose upon a prominent sagittal crest. Its occipital border curves from the base of the mastoid process upward and backward to the summit of the inion.

The squamous portion of the temporal bone is nearly vertically convex, and is an inch in height above the root of the zygomatic process.

The squamous suture at its upper part pursues a course almost horizontal for nearly three inches. At its posterior part, in the particular specimen under investigation, there are two deep, ascending, vascular grooves.

The orbit has about the same form as in *Rhinoceros occidentalis,* but in the specimens its floor is more superficial.

The optic foramen is large and vertically oval, and is placed an inch in advance of the spheno-orbital foramen.

The margin of the orbital entrance is as well defined as in *Rhinoceros occidentalis;* but the supra-orbitar process is neither quite so prominent nor so rough.

The post-orbital process, though merely the termination of the supra-orbital margin, is nevertheless well marked compared with its condition in *Rhinoceros indicus*.

As in the latter, there exists a prominent lachrymal process; but there are two lachrymal foramina, placed one above the other internal to the process.

The malar bone is robust, and in its course is directed a trifling degree more outward than in *Rhinoceros occidentalis*, and its external face presents more upward.

The alveolar portion of the face is vertical, but antero-posteriorly is convex. The position of the lachrymal bone presents an oblique slightly depressed surface.

The infra-orbital foramen is placed about an inch above the interval of the second and third molar teeth.

In all the specimens, the remainder of the face is too much broken to form any correct idea of its form.

Superior View.—(Pl. XIV. 11.) The forehead, preserved nearly entire in one specimen, is broad, and above the orbits is elevated and convex, but is depressed towards the median line. The temporal ridges converging from the post-orbitar processes are relatively not so prominent as in *Rhinoceros occidentalis;* but, as in this, they evidently conjoin to form a sagittal crest.

Posterior View.—(Pl. XIV. 12.) The inion has a more trilateral outline than in *Rhinoceros indicus*, and in the middle it is much more bulging or prominent, so that the superior angular margin of the foramen magnum projects considerably posterior to the basilar margin. Towards the summit the median portion of the surface of the inion becomes depressed, and each side is directed quite laterally in its course to the temporal margin.

The occipital condyles are more vertical in their relation to one another than in *Rhinoceros indicus;* and above each there is a well-marked depression of the surface.

The occipital foramen is subrotund, and about ten lines in diameter, and it has an angular margin above and a concave one below. It is directed backward and a little downward.

Inferior View.—(Pl. XV. 2.) In the specimen in which the base of the skull is preserved, the junction of the basilar process and sphenoidal body is completely obliterated. Near its position on each side is a superficial rough elevation for muscular attachment.

The median line of the basilar process is prominent, and each side is slightly depressed.

The sphenoidal bodies are prominently convex, and within the roots of the pterygoid processes slope on each side to form a broad shallow groove for the Eustachian tube.

Separated by the anterior scroll-like terminations of the occipital condyles, a distance of ten lines, are the anterior condyloid foramina, which are oval and three lines in diameter antero-posteriorly.

To the outside of the latter, and a little in advance, is the para-mastoid process, existing in the specimen as a broad stump, compressed antero-posteriorly.

The mastoid process forms the posterior abutment of a high arch conducting to the entrance of the tympanic cavity, or in other words the meatus auditorius, as it

exists in *Rhinoceros indicus*, is open at the bottom. The process is strong and is bent forward at its apex, which is tuberous and extends nearly as far downward as the post-glenoid tubercle, from which it is about five lines distant.

The pars petrosa is quite small. It appears at the bottom of the arch between the post-glenoid and para-mastoid processes, as a V-shaped body, bent forward at its lower part by the base of the styloid process.

The remaining portion of the latter, in the specimen, is a stout cylinder clasped antero-internally by the os petrosa.

Between the bottom of the styloid and para-mastoid processes is the stylo-mastoid foramen.

The foramen lacerum is a very large reniform vacuity, being about an inch in diameter antero-posteriorly, and about four lines transversely.

In advance of the latter a few lines is a distinct foramen ovale, and a short distance antero-internal to this is a round foramen, conducting into the homologue of the foramina rotundum and spheno-orbitale.

The latter opens at the bottom of the orbit just internal to a pointed process arising from the conjunction of three ridges; one of which comes from the margin of the foramen, the other from above the position of the optic foramen, and the third constitutes the boundary of origin between the temporal and external pterygoid surfaces.

The optic foramen is placed about an inch in advance of the spheno-orbitale.

The glenoid articulation is more concave than in *Rhinoceros indicus*, and that portion of its surface situated on the anterior part of the root of the zygomatic process presents more backward and outward.

The post-glenoid tubercle, compared with that of *Rhinoceros indicus*, is relatively short; at its outer margin being ten lines in length, and it projects only two lines below the mastoid process. What it loses in length it gains in robustness and breadth; and its outer side is rough, and the apex truncated. Posteriorly it is perforated by a vertical foramen.

The interpalatine notch extends forward as far as the posterior third of the penultimate molar tooth.

The hard palate is strongly arched, though not so much as in *Rhinoceros occidentalis*, and it also differs from that of the latter in being relatively broader, and less convergent at the alveolar margin anteriorly.

Inferior Maxilla.—(Pl. XIV. 2.) The body of the lower jaw externally is vertically convex, and anteriorly is more convergent than in *Rhinoceros indicus*. Its depth below the posterior molar tooth is about twenty lines; below the first molar, fifteen lines. The base is rounded, and is about as convex antero-posteriorly as in the last mentioned species.

In the specimen under investigation, the symphysis is broken off a few lines in advance of the molars, and it there presents a crescentic surface only ten lines broad and six deep, indicating the inferior incisor teeth to be of small size in this species. Upon each side of the broken surface, about three-fourths of an inch from the position of the first molar teeth, there remains the end of the fang of the external incisors.

The anterior mental foramen occupies a position near the base of the bone below the hinder fang of the second molar of the remaining series. In advance of it, on nearly the same line, are two other and smaller foramina of the same kind.

A portion of the ramus shows this to have been thin and deeply excavated internally, as in the Tapir. The posterior mental foramen is large, and placed about one inch behind the last molar tooth.

Dentition.—Except the first inferior molar tooth, which is shed at an early period, the entire series of permanent molar teeth in *Rhinoceros Nebrascensis* is retained to a late period of life, as is indicated by the specimen of a skull of a very old individual in the collection of Dr. Owen, in which, although the crowns are almost completely worn away, yet the whole number remains.

From minute fragments of fangs of an upper and lower incisor existing in two of the adult specimens under investigation, we are satisfied of the existence of these teeth permanently, but the number we have no means of ascertaining.

Superior Molars.—(Pl. XIV. 1, 13; XV. 3.) The upper molars bear a very great resemblance in form to those of *Aceratherium incisivum;* and they possess a basal ridge all round except at the inner side of the bases of the internal lobes of the true molars, and where it has been obliterated by pressure from the teeth in contact.

The outer surface of the true molars is broad and slightly depressed at the middle, and at the anterior fifth forms an abrupt fold, as in all other species of *Rhinoceros.*

The last molar exhibits a disposition to the development of a posterior valley, or rather a separation, as in the other molars, of the postero-internal and external lobes. The anterior valley of this tooth is almost as deep as the crown, is nearly level at bottom, and is bounded at its entrance by a mammillary eminence, which is a portion of the basal ridge. The hinder lobe is quite simple, and exhibits no tendency to encroach upon the anterior valley; but the antero-internal lobe at its middle posteriorly protrudes considerably into the latter.

The inner lobes of the true molars in advance expand gradually to their base, are impressed anteriorly, and protrude into the valleys about their middle posteriorly. The valleys are of equal depth at their outer extremities or termination, and the principal ones, except in the penultimate tooth in one specimen in which the bottom throughout is nearly uniform, deepen towards their entrance, so that in the trituration to which the teeth are subjected in mastication, as in *Rhinoceros occidentalis* and *Aceratherium incisivum*, they become obliterated from without inwardly. The entrance of the anterior or principal valleys in the fifth and sixth molars is not obstructed by the existence of a constituent portion of the basal ridge, as in *Rhinoceros occidentalis.*

A small fragment of an upper jaw, presented to the Academy of Natural Sciences by Mr. Alexander Culbertson, contained the crowns of the four premolars entirely concealed within the bone. These, having been divested of their hard envelop, are remarkable for their state of preservation and beauty, and lead me to describe them more minutely than may be considered essential. (XIV. 4–8.)

The first premolar is only three-fourths the size of the others, and it is trilateral with the inner and posterior sides, forming a continuous convexity. The posterior

three premolars increase slightly to the last one, and they are quadrate and have the inner side convex and narrowest.

The outer side (4) of these teeth forms a large quadrilateral surface with rounded angles. It is slightly convex, and is feebly waved longitudinally. At the fore part a narrow fold descends from the base and expands towards the triturating margin; but it is successively less developed forward, and in the first of the series is rudimentary. This fold increases in depth in the true molars, and is quite characteristic of the outer part of these teeth in *Rhinoceros*, as it does not exist in *Palaeotherium*, *Titanotherium*, nor *Anchitherium*.

In advance of the fold just described, the antero-external margin of the molars projects forward and slightly outward, and looks like an independent column or buttress, and is the shortest portion of the outer lobes.

The triturating margin of the latter, in the specimens of premolars under especial examination, is bilobed and acute.

The inner surface of the postero-external lobe is a little convex, and from the same surface of the antero-external lobe in the third and fourth premolars an abrupt fold projects into the principal valley of the teeth (5). This fold, when the teeth are partially worn away, gives the termination of the principal valley a bifurcated appearance; and in *Rhinoceros indicus* and *Rhinoceros tichorinus* it is the extension and confluence of the fold with the anterior part of the postero-internal lobe of the teeth which produces a division of the principal valley, represented when the teeth are considerably worn away by two enamel pits.

The internal lobes have acute summits and more or less expanding bases, and, except in the first tooth, their inner extremities for more than half their depth are confluent, so that the principal valley is a deep pit, with shelving sides and an internal notch (5, 6).

In the fourth premolar, the postero-internal lobe is a sigmoid fold projecting from the confluence of the outer lobes.

In the three premolars in advance, the postero-internal lobe consists of two portions; an inner pyramid with two broad sides directed obliquely antero-posteriorly, and a bent fold extended between the confluence of the outer lobes and the outer side of the pyramid, and separating the two characteristic valleys of the teeth. This fold does not reach the summit of the inner pyramid, nor of the outer lobes, and it looks more like a narrow partition separating the valleys than a constituent portion of the postero-internal lobes.

The antero-internal lobe of the premolars, except in the first, is directed transversely inward on a line with the characteristic fold of the outer surface of the teeth, and it expands as it approaches its termination, and antero-internally swells into a sort of conoidal buttress, gradually increasing in distinctness from the second to the last premolar. In the first premolar it appears only as a small, compressed mammillary eminence of the basal cingulum.

The latter, as in *Rhinoceros occidentalis*, is well developed upon all the premolars. In the specimens under special examination, ossification had not yet advanced to its production, externally (4), but in older specimens in this position it measures over a line in depth (1). At the postero-external margin of the teeth it very

abruptly descends half the length of the crown (6), then, proceeding inward, it envelops the base of the postero-internal lobe, and internally it ascends to the base of the antero-internal lobe, and winds anteriorly to the antero-external margin of the crown, and then makes an abrupt ascent to the base externally (7, 8).

The anterior and posterior valleys in all the premolars are deep culs-de-sac with shelving sides (5).

When the molar teeth have had one-half their crown worn away in mastication they are hardly recognizable in those which have not been subjected to trituration. Comparatively with one another, they of course suffer attrition most in the order of their succession, and this, judging from the specimen in Dr. Owen's collection, in which the seventh molar is only partially protruded, may be determined to occur in the following manner. After the temporary teeth, the fifth molar is protruded, and in the permanent series appears most worn; then succeed the first to the fourth permanent molars, then the sixth, and finally the seventh (13).

In the specimen of the skull containing all the molars, presented by Capt. S. Van Vliet to the Smithsonian Institution, these teeth are worn about one-half away, and exhibit very strikingly the transformation of form produced by attrition. (XV. 3.)

The enamelled grinding surface of the fifth molar, except a short inlet constituting the entrance of what was the principal valley, has been completely obliterated. The exposed dentinal surface is concave, and bordered by enamel, except anteriorly and posteriorly, where it also appears to have been removed, probably from the combined influence of long-continued pressure and friction from the contiguous teeth.

In the sixth molar, the exposed dentinal surface is more deeply bilobed internally than in the former; or, in other words, a longer tract of enamel remains from the anterior valley; and farther, almost the whole of the bottom of the posterior valley yet remains.

The seventh molar, from its being the last to take its position in the functional series, is worn less than any of the others. Its valley remains entire, except that it is rendered a little more shallow, from the summits of the lobes which embrace it being worn off. The exposed dentinal surface presents an irregular V-shaped figure, with the apex and extremities of its arms bifurcated.

The second to the fourth molars inclusive present nearly square dentinal surfaces bordered with enamel, bilobed internally, and possessing, each, two trilateral pits of enamel, the remains of the valleys. The central pit is the larger, and has convex sides and rounded angles; and the smaller pit is in contact with the posterior border of the teeth.

The exposed dentinal surface of the first premolar, in the specimen, upon one side of the jaw, has two small circular pits of enamel, and on the other, a single trilateral pit, which remains from the posterior valley; and in both teeth a cul-de-sac in connection with the internal border exists before and behind the rudimentary antero-internal lobe.

When the enamelled triturating surfaces of the molars are completely obliterated by mastication (1, 2), as is the case in the specimen of a skull of a very old animal in the collection of Dr. Owen, the exposed dentinal surfaces are quadrate and bilobed

internally, a little broader transversely than antero-posteriorly, smooth and more or less depressed. Most of the crowns are bordered with enamel only at their internal portion; it having entirely disappeared upon the true molars externally, and probably also upon the premolars, but these, in the specimen, are too much broken at their outer part to judge. Between the teeth also the enamel has partially and in many positions entirely disappeared, so that the dentinal masticating surfaces are separated only by the interstices of the crowns.

Inferior Molars.—(Pl. XIV. 2, 3.) The normal number of lower molar teeth of *Rhinoceros* is seven, as in the upper jaw; but in the only specimen of the lower jaw of *Rhinoceros Nebrascensis* which we possess, the number of molars on each side is six; the first having been long shed and its alveolus entirely obliterated.

In form, the inferior molars resemble closely those of all other species of *Rhinoceros*. All have a basal ridge surrounding them, except where it has been obliterated, in the course of time, by pressure and friction between the teeth.

The second molar of the normal series, in outline transversely, presents an isosceles triangle, but, like the others, it is constituted of two distinct lobes, of which the anterior is so much compressed laterally as to lose the crescentoid form.

In the specimen of the lower jaw accompanying the skull obtained by Captain Van Vliet, the crowns of the molars are considerably worn away. The fifth molar has its two crescents nearly obliterated; the sixth is less worn; and then follows in succession the fourth to the second, and then the seventh. In the latter, the exposed dentinal surfaces of the crescentic lobes are distinct, but in all the others they have become confluent. From the long continuance of pressure and friction the enamel has disappeared where the teeth are in contact, except between the anterior and the posterior two.

In a small fragment of lower jaw accompanying the skull of a very old animal in Dr. Owen's collection, containing the fifth molar, the enamel of this has been worn away, except a very small portion at each posterior angle, and the masticating surface of dentine in outline has the form of the figure 8, and is transversely convex and antero-posteriorly concave. Small fragments of the teeth in advance and behind, in the same specimen, indicate them not to have been as much worn, so that the nearly entire tooth is probably the first of the true molar series.

Temporary Molars.—The posterior three temporary molars, as I suppose them to be, contained in a fragment of the upper jaw, are of about the same size as their permanent successors (XIV. 14). They are more square, or are less contracted and convex internally, and the inner lobes are more equal in size, and do not become confluent internally. In consequence of the latter arrangement, the principal valleys are open at their entrance to the bases of the lobes, and in the third and fourth molars they deepen from without inward, as in the case of the two anterior permanent true molars. In these two temporary teeth, also, the posterior valleys are deeper at their outer end than those anterior. In the second molar, the bottoms of both valleys are nearly uniform in their depth throughout and with each other. The basal ridge is horizontal upon the inner side of the temporary molars, and in front and behind very gradually descends to the external margins of the crown.

The inferior last temporary molar preserved unworn, in company with the first permanent true molar protruded, in a fragment of lower jaw, exhibits a disposition to the formation of three lobes, by the ordinary anterior normal lobe being deeply notched at its anterior horn, while in advance of this a smaller transverse lobe, slightly bent forward and inward, is developed at its outer side. A continuous basal ridge surrounds the tooth, which otherwise than in the characters given corresponds with the permanent molars. (XIV. 9, 10.)

MEASUREMENTS OF THE HEAD AND TEETH.

	Inches.	Lines.
Length of skull from the upper margin of the occipital foramen to the anterior part of the first molar tooth	9	0
Breadth of inion at ends of mastoid processes	3	0
Greatest breadth at the zygomata (estimated)	5	2
Breadth at the post-glenoid tubercles	3	4
Distance from meatus auditorius to the lachrymal tubercle	4	6
Height of face from the alveolar margin on a line with the middle of the orbit	3	4
Greatest breadth of forehead at the supra-orbitar processes	3	5
Breadth of hard palate about its middle	1	7
Length of upper molar series	4	10
Length of lower molar series	4	4
Breadth of last superior molar	0	11
Breadth of fourth molar	0	11
Breadth of first molar	0	6
Antero-posterior diameter of fifth upper molar	0	11
Antero-posterior diameter of second upper molar	0	8½
Antero-posterior diameter of first upper molar	0	6½
Antero-posterior diameter of last lower molar	0	11
Antero-posterior diameter of first (of six)	0	7½
Breadth of fourth lower molar	0	6½

CHAPTER III.

CARNIVORA.

Fam.—DIGITIGRADA.

Gen. **MACHAIRODUS,** KAUP.

THE genus *Machairodus* was proposed by Kaup upon specimens of upper canine teeth, found in the later tertiary deposits of Europe, remarkable for their length, falciform shape, and serrulated margins. They had been previously referred to the genus *Ursus*, but the discovery in France, by M. Bravard, of an almost entire skull containing a tooth like those in question, decided the animal to belong to the feline family.

Several species occurring in Europe and India have since been indicated, and the skull of a very large one was discovered by M. Lund in the caverns of Brazil.

Machairodus primaevus, LEIDY AND OWEN.

(PLATE XVIII.)

Machairodus primaevus, Leidy and Owen: Proc. Acad. Nat. Sci., 1851, v. 329; Owen's Rep. of a Geol. Surv. of Wisc., etc., 564.

Among the mammalian remains brought by Dr. Evans, while engaged in the geological survey of Dr. Owen, from the Mauvaises Terres of Nebraska, is the head of a small species of *Machairodus*, which is probably the most ancient known.

The species was characterized in the Proceedings of the Academy of Natural Sciences under the name of *Machairodus primaevus*.

The specimen upon which the latter is established is very much fractured and fissured, and it has the summit of the inion, the zygomata, anterior extremities of the ossa nasi, superior incisors, and the greater portion of the corresponding canines, and the symphysis of the lower jaw with the incisors and canines, broken away. When first received, it was partially enveloped in a matrix, which, though having the same general appearance as that inclosing all the other mammalian fossils from Nebraska, was unusually hard. Attached to the mass, but separated from the skull, was the greater portion of a tooth, which I have considered to be of an inferior canine of the same animal; but it may be one of the upper incisors, which, as indicated by the alveoli, are relatively very large compared with the corresponding teeth of *Felis*.

The head of this species is about half the size of that of *Machairodus neogæus*, and indicates an animal about one-fifth smaller than the American Panther, *Felis concolor*.

Lateral View.—(Pl. XVIII. 1.) In the side view, the upper outline of the skull is more convex antero-posteriorly than in the species of *Machairodus* just mentioned or the Panther, from the greater elevation of the forehead above the orbits posteriorly.

The ossa nasi are not prominent above the border of the upper extremity of the os maxillare superius, as in *Felis*, but are concealed from view laterally, and the anterior slope of the head is more uniform in its descent, or is less arched than in this genus.

The temporal fossa relatively to that of *Felis* is shorter, of greater breadth, and much greater depth. The anterior surface of the zygomatic root inclines at an angle of about 50°, instead of being nearly horizontal, as in *Felis*. The temporal surface generally disposes to be much more rapidly convergent towards its exit inferiorly than in the latter, and indeed the whole arrangement of the temporal fossa is such as to have given a much less oblique course to the fibres of the temporal muscle.

The entrance to the meatus auditorius is not a broad archway, as in *Felis*, but is a relatively deep narrow arch, apparently resulting from a modification of that in the latter genus, produced by the root of the zygomatic process being depressed downward and backward. The meatus is bounded posteriorly by a relatively very robust and distinct mastoid process, which is directed downward and forward, and has a broad rough apex for muscular attachment. The posterior surface of the process curves upward and backward, and its base abuts against the paramastoid process, which is a short, thick, roughened tuberosity.

The form, relative size, and direction of the orbit are the same as in *Felis;* being ovoid, with the narrower part above. It is an inch and four lines in vertical diameter, and has the plane of its entrance inclined at an angle of about 50°; presenting outward, forward, and upward.

The infra-orbitar foramen is vertically oval, and not only relatively but absolutely very much larger than that of the Panther. It is about half an inch in vertical diameter and five lines transversely, and is situated internal to the position of the orbit, with more than half its extent placed above the line of the lower margin of the latter.

Above the foramen, just in advance of the orbital margin, the surface is more definitely concave than in *Felis*, and anterior again to this the convexity of the canine alveolus commences.

In the specimen, the upper carnassial tooth is placed far external to the tooth in advance, but this relation of position appears to be the result of a dislocation inward of the latter, and it is most probable that in the natural condition the upper molars were arranged in an oblique line convergent forward and upward, as in *Felis*.

The anterior portion of the external alveolar surface is transversely concave, but vertically is very strongly convex in comparison with what it is in the latter genus.

Superior View.—(XVIII. 2.) In the upper view of the skull, the temporal surfaces above the position of the roots of the zygomatic processes are much less

convex than in *Felis*, and just behind the post-orbital processes are more deeply excavated and of much greater vertical extent.

The sagittal crest, though broken in the specimen, can yet be seen to have been prominently elevated and strong to the point of its bifurcation.

The forehead is much more strongly arched than in *Felis*, and also is more depressed along its median line.

The coronal and squamous sutures are entirely co-ossified in the specimen, and the frontal suture is also obliterated, but its original position is indicated by a rugged line.

The face is relatively much broader superiorly than in *Felis*, and along the sides of the ossa nasi it is rendered prominently convex by the greater degree of extension, upward and backward, of the canine alveoli than in the latter genus.

The posterior portions of the ossa nasi, remaining in the specimen, are relatively narrow compared to those of the Panther, are placed slightly below the general level of the corresponding part of the forehead and face, and are quite flat and slightly inclined towards each other.

The intermaxillaries are not quite so prominent forward as in *Felis*, but they are rather stronger, in accordance with the greater size of the incisive teeth.

The inion, which at its upper part is broken, appears to have had nearly the same form as in *Felis;* but the short thick paramastoids are situated higher, and the fossæ between them and the occipital condyles are less deep.

The latter and the occipital foramen have the same form and relative size and position to each other as in *Felis*. The foramen is transversely oval, nine lines in its greater, and six and a half lines in its shorter diameter.

The base of the skull, for the most part, is enveloped in a hard matrix, which to remove would endanger the integrity of the much fissured specimen; nevertheless it presents a few points visible and worthy of notice.

The mastoid processes are a little more advanced in their position, and more internally situated than in *Felis*.

The anterior condyloid foramina are more exposed in their position than in *Felis*, or rather they are not directed to the same extent into the exit of the jugular canal.

The auditory bullæ, though broken away in the specimen from their remaining connections, may be inferred to have been as well developed as in *Felis*.

Inferior Maxilla.—(Pl. XVIII. 1, 3.) The lower jaw corresponds in its general form with that of the latter, but it presents the same remarkable characters as in the other known species of *Machairodus*.

The coronoid process is relatively very short compared with that of *Felis*, and, instead of curving backward, its posterior border is quite vertical to the base of the bone.

The extent of the fossa below the coronoid process, and the form of the condyle, are about the same as in *Felis*.

The post-coronoid process is short and thick, and is bent outward instead of inward, as in *Felis*.

The external surface of the lower jaw, near the base and below the position of

the first premolar, presents the commencement of a ridge, which no doubt passed to an alary process of the symphysis, such as exists in *Machairodus neogaus* and other species.

Nine lines of the hiatus in advance of the molars exists in the specimen, without any disposition anteriorly to expand for the accommodation of the canine alveolus. Its margin is acute, and, viewed from the broken part, appears a little everted. Below it externally the surface slopes in a slightly convex manner outwardly to the base of the bone, and it presents two small mental foramina.

Dentition.—(Pl. XVIII. 1, 3, 4, 5.) The upper jaw in the specimen contains the incisive alveoli filled with matrix, portions of the canines, the alveolus for the first molar, and all the other molars except the posterior two of the left side. The lower jaw contains only the molars.

Characteristic of *Machairodus*, the superior incisive alveoli indicate the possession of larger incisors than exist in *Felis*. Laterally they border so closely on the canine alveolus that a smaller hiatus is left than in other species of the genus, and they increase in size from the first to the last.

The upper canine (1) is laterally compressed, and is relatively much less broad than in *Machairodus neogaus*, and was about half as long and broad as that of *Machairodus cultridens*. In the fragment, preserved in the specimen, the posterior sub-trenchant edge, about ten lines below the enamel border of the crown, commences to be crenulate, as in other species of *Machairodus*. Antero-internally there exist the remaining three lines of a ridge, which commences near the enamel border and proceeds downward and forward, and at its lower third is also crenulated. In section the upper canine is elliptical, and is acute posteriorly, and at the enamel border of its crown measures seven lines and a half in breadth, and about four lines and a half transversely.

The first superior molar, as indicated by the remaining alveolus, had a simple mammilloid crown, as in *Felis*. The alveolus is subrotund, about one and a half lines in diameter, and borders closely upon that for the canine.

Posterior to the first molar, a relatively very large hiatus exists compared with that of *Felis* and other species of *Machairodus*, being four lines in length, or equal to the whole interval between the canine and second molar of *Machairodus neogaus*.

The crown of the last mentioned tooth (3), compared with that of the Panther, is shorter relatively to its breadth, and in comparison of size with that of the carnassial tooth is relatively very much smaller than in any species of *Felis*. Its outer surface has the same inclination and prominent base as in the latter, but is less convex. It is composed of a median compressed mammillary cusp, with a trenchant margin, a small anterior lobe, as in *Machairodus neogaus*, and a posterior, simple, compressed mammillary lobe with a trenchant border, relatively equal to the corresponding pair in the latter species and in *Felis*.

The crown of the upper carnassial tooth (1) has about the same relative size as in the latter genus, and also the same degree of inclination of its outer surface, but it does not possess the lenticular fossa at the conjunction of the median cusp with the posterior lobe. The anterior lobe descends much lower than in *Felis*, so as to shorten very considerably the corresponding margin of the median cusp,

which in this position is more vertical and posteriorly is more oblique. The posterior lobe is broad as in *Felis*, but is less oblique at the trenchant margin, which also is indented as in the latter genus.

The crown of the tubercular molar (1) is transversely oblong, as in the Domestic Cat, is three lines broad by two antero-posteriorly, and externally forms a mammillary tubercle, and posteriorly a smaller one.

As previously mentioned, the symphysis of the lower jaw, with the incisors and canines, is broken away from the specimen.

The portion of tooth supposed to be part of an inferior canine (4, 5) is of the right side. It corresponds in its form and relative size with that of *Machairodus neogaus;* having a curved demi-conoidal crown, with the postero-internal side defined by longitudinal ridges, of which that external is most salient. At the enamel border this tooth measures three lines antero-posteriorly and two transversely.

The first inferior molar (3) is relatively very much smaller than in *Felis*, and in form it is like that of *Machairodus cultridens;* the crown being compressed conoidal, with a small simple basal lobe anteriorly and posteriorly.

The second molar (3) is less robust in its proportions than in *Felis*, and has the same form nearly, very much increased in size, of the first tooth; for the posterior lobe, though broken in the specimen, appears to be quite simple, or it is without the prominent heel existing in the latter genus, and the division possessed by *Machairodus neogaus.*

The inferior carnassial tooth (3) is quite peculiarly modified from the feline type, and if it had been found as an isolated and unique specimen, it would certainly have led to the separation of the species from the genus *Machairodus.* It possesses the two characteristic lobes, separated by a large angular notch with trenchant margins, as in *Felis*, but the slight posterior heel of this genus is developed into a broader lobe than that occupying a similar position in the tooth in advance. This third lobe is more than half the length of the crown, is depressed externally and notched at its upper posterior angle. It exists only in a rudimentary condition in *Machairodus neogaus.*

MEASUREMENTS.

	Inches.	Lines.
Length from occipital condyles to upper incisive alveoli	6	5
Length from occipital condyles to lachrymal tubercle	4	4½
Height from base of lower jaw to forehead	3	10
Breadth of cranium at most prominent part of temporal fossæ	1	10
Breadth of forehead at post-orbitar processes	2	8
Breadth at ossa malæ below their orbitar processes	4	4
Breadth of face from inner side of infra-orbitar foramina	1	9
Breadth at most prominent part of the canine alveoli	2	1
Height of coronoid process from base of lower jaw	1	7
Height of latter below first molar	0	11
Antero-posterior diameter of second upper molar	0	5½
Antero-posterior diameter of upper carnassial tooth	0	10
Antero-posterior diameter of first lower molar	0	3
Antero-posterior diameter of second lower molar	0	6
Antero-posterior diameter of lower carnassial tooth	0	8½

CHELONIA.

CHAPTER I.

TESTUDO, LINNAEUS.

ALL the fossil turtles from Nebraska, which have come under my inspection, belong to the genus *Testudo*.

In the ordinary constitution of *Testudo*, the osseous carapace is composed of ten vertebral plates, eight pairs of costal plates, and eleven marginal plates upon each side of a symmetrical nuchal and pygal plate.

Fig. 1.

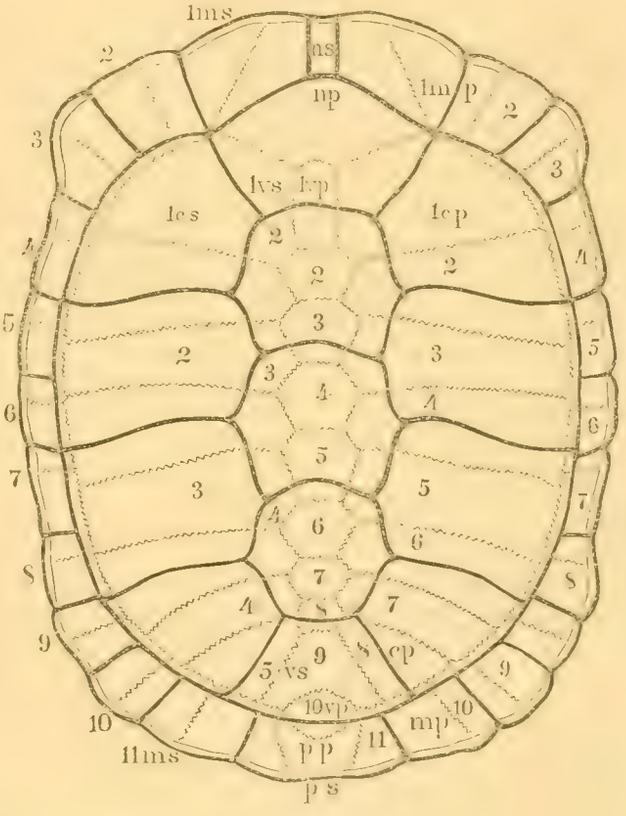

Fig. 1. Ideal view of the structure of the carapace of Testudo. The dark outlines indicate the boundaries of the scutes; the serrated lines, the limits of the plates. 1vp—10vp (*median line*), vertebral plates; 1cp—8cp (*right hand*), costal plates; 1mp —11mp, marginal plates; np, nuchal plate; pp, pygal plate; 1vs—5vs, vertebral scutes; 1cs—5 (*left*), costal scutes; 1ms—11ms, marginal scutes; ns, nuchal scute; ps, pygal scute.

The first vertebral plate is oblong quadrilateral; the succeeding plates, to the eighth inclusive, are most usually hexahedral; the penultimate plate is inverted V

shaped; and the last of the series is rhomboidal, and is included in the notch of the latter and one similar of the pygal plate.

The costal plates are alternately broader and narrower.

In the recent condition, the carapace is invested by corneous scutes, which impress it with their form.

There are five vertebral scutes, four pairs of costal scutes, and eleven marginal scutes upon each side of a narrow symmetrical nuchal scute and a broad undivided pygal scute.

The plastron or sternum of *Testudo* is composed of a single, more or less pyriform, entosternal plate, inclosed by a pair of episternal and hyosternal plates, and posterior to the latter of a pair of hyposternal and xiphisternal plates.

Fig. 2.

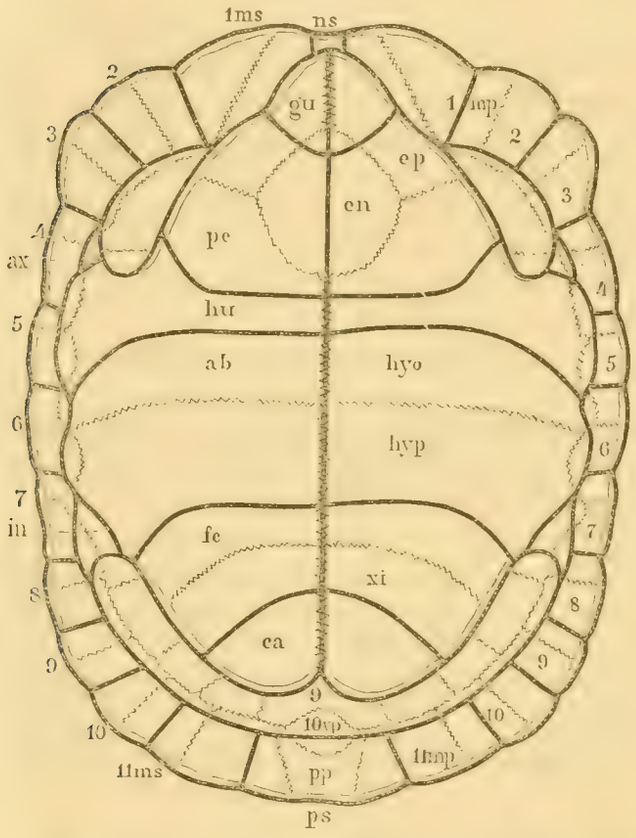

Fig. 2. Ideal view of the structure of the sternum of Testudo. en, entosternal plate; ep, episternal plate; hyo, hyosternal plate; hyp, hyposternal plate; xi, xiphisternal plate; gu, gular scute; pc, pectoral scute; hu, humeral scute; ab, abdominal scute; fe, femoral scute; ca, caudal scute; 1mp—11mp (*right*), marginal plates of the carapace; 1ms—11ms (*left*), marginal scutes of the carapace; ns, nuchal scute; ps, pygal scute; 9, 10vp, vertebral plates; pp, pygal plate.

The corneous scutes of the sternum, which impress their osseous basis, consist of eight pairs, as follows: the gular, pectoral, humeral, axillary, abdominal, femoral, inguinal, and caudal scutes.

Dr. Evans, in the Geological Report of Dr. Owen, before quoted, states that fossil turtles were found in a portion of the Bad Lands, some five or six miles in extent, having much the appearance of an ancient lake, where it is entered from Bear Creek, a tributary of the Cheyenne. At one of these lake-like expansions hundreds of fossil turtles were discovered. They do not rest immediately on the grassy plain that forms the present floor or bottom, but on the talus and debris, collected into

mounds, which have been derived from the disintegration of the marly earths that have slid from above. The particular stratum in which they seem to have been originally imbedded, is a pale flesh-colored, indurated, siliceous, marly limestone, situated from thirty to forty feet above, as shown in Number 7 of the geological section, page 13 of this memoir. In the succeeding pages I shall describe five species of *Testudo*, but at the same time I suspect that they may not all be truly distinct.

Testudo Nebrascensis, Leidy.

(Plate XIX.)

Stylemys Nebrascensis, Leidy: Proc. Acad. Nat. Sci., 1851, v., 172.
Testudo Nebrascensis, Leidy: Proc. Acad. Nat. Sci., 1852, vi., 59; Owen's Rep. of a Geol. Surv. of Wisc., etc., 567.

Of this species I have the opportunity of examining four specimens from the collections of Messrs. Culbertson, Captain Van Vliet, and Dr. Owen. All are more or less broken, and two are crushed; all have lost the anterior and posterior marginal plates, and in one the carapace is almost entirely gone. They vary a little in size, and apparently belonged to immature individuals, as the costal plates had not yet been connected to the marginal plates by cartilage.

The form of the species approaches very much that of the genus *Emys*, and is more depressed than the Gopher, *Testudo polyphemus*.

The marginal plates are oblique at the sides of the carapace, and turn abruptly beneath at their lower third.

The processes of the sternum, which act as columns of support to the carapace, at the bottom of the lateral notches are remarkable for their prominence and thickness. Those anterior are twenty-one lines long, four lines broad, and two and a half lines thick, and ascend inwardly at an angle of about 45°, and are received at their free extremity into a pit about the middle of the outer margin of the first costal plate. Those posterior are equally strong with the former, and join the carapace at the junction of the fifth and sixth costal plates.

The sternum is flat, turned a little upward anteriorly, and is slightly convex at its junction with the carapace.

The axillary and inguinal notches are directed downward; and the line of union of the sternal with the marginal scutes is nearly parallel on the two sides.

The species is the smallest and most depressed of those brought from Nebraska, and in all the specimens the arrangement of the plates is the same, except in the smallest, which has an additional vertebral plate introduced between the ordinary eighth and the inverted V-shaped penultimate plate.

Plates of the Carapace.—(Pl. XIX. Fig. 1.) The first vertebral plate has convex sides, and in the smallest specimen, being the only one in which it is preserved, is ten lines long and six broad. The vertebral plates, from the second to the eighth inclusive, are hexahedral; and to the fifth are nearly equal in size, but afterwards undergo a rather sudden reduction, and then also continue to be nearly equal.

The second vertebral plate articulates with the first and second pairs of costal

plates; the third with the second and third; and in the same manner the remaining vertebral plates, to the eighth inclusive, articulate each with two pairs of costal plates.

The first costal plate joins the first to the third marginal plate inclusive.

Plates of the Plastron.—(Pl. XIX. Fig. 3.) In the largest specimen of *Testudo Nebrascensis*, in which the sternum is best preserved, the entosternal plate is pyriform, and measures one and a half inches long by sixteen lines broad. It encroaches for a third of an inch upon the position of the gular scutes, and extends within a line of the humeral scutes. In the other specimens, the entosternal plate reaches the boundary of the latter.

In the largest specimen, the episternal plates are one and a half inch long.

The hyosternal plates are two and a quarter inches long, and in all the specimens articulate with the third to the fifth marginal plates inclusive.

The hyposternal plates, in the smallest specimen, are one and a half inch long, in the largest two inches; and they articulate with the postero-inferior angle of the fifth marginal plates, and the sixth and seventh of the latter.

Scutes of the Carapace.—(Pl. XIX. 1.) The vertebral scutes, from the second to the fourth inclusive, are hexahedral, and are broader than they are long. The second and third are nearly equal in size, and in the smallest specimen measure about nineteen lines broad by fifteen long. The fourth vertebral scute is sixteen lines broad by fifteen long, and in another specimen, twenty broad by sixteen long, and it has the postero-lateral sides more convergent backward than in the preceding scutes.

Scutes of the Plastron.—(Pl. XIX. 3.) Upon the sternum, in all the specimens, the scutes agree in the details of their arrangement, except that in the smallest the anterior margin of the humeral scutes courses along the bottom of the axillary notches, but in the others turns forward and outward to the latter.

The gular scutes, the position of which is preserved in the largest specimen, are one inch in length and are angular posteriorly.

The pectoral scutes are two inches and one line long.

The humeral scutes internally measure a half an inch in length, but externally expand before and behind, and join the axillary and the fourth and fifth marginal scutes. In the smallest specimen they reach to the sixth marginal scutes, but in the largest one not within several lines.

The abdominal scutes of the largest specimen are two inches two lines long, but are a fourth of an inch less in the smallest one, and in this they join the sixth and seventh marginal and the inguinal scutes, and in that several lines of the fifth marginal scutes in addition.

The lines of junction of the scutes of the sternum with those of the carapace are nearly parallel on the two sides, and are undulant and intersect the sutural connection of the contiguous plates.

The axillary scute rests upon the hyosternal and third marginal plates between the humeral and fourth marginal scutes.

The inguinal scute is supported upon the hyposternal plate, and in the largest

specimen upon the sixth and seventh marginal plates, but in the smallest upon the seventh only, between the abdominal and seventh marginal scutes.

MEASUREMENTS.

	THREE SPECIMENS.		
	Smallest.	Medium.	Largest.
Estimated length of sternum			7 in.
Breadth of sternum at inferior border of marginal scutes	4¾ in.	4¾ in.	5½ in.
Length of transverse curve of the carapace from the level of the sternum	8¾ in.		
Height from the level of the sternum	3 in.		
Length of the lateral marginal plates	1½ in.	1¾ in.	
Height of latter from the level of the sternum	1½ in.		

Testudo hemispherica, Leidy.

(Plates XX., XXIV. Fig. 3.)

Emys hemispherica, Leidy: Proc. Acad. Nat. Sci., 1851, v., 173.
Testudo hemispherica, Leidy: Proc. Acad. Nat. Sci., 1852, vi., 59; Owen's Rep. of a Geol. Surv. of Wisc., etc., 570.

This species originally was established upon a specimen consisting of the sternum with a small portion of the carapace attached, from the collection of Capt. Van Vliet.

In Dr. Owen's collection, a nearly entire carapace and sternum of the same species are preserved.

The carapace is relatively more convex and hemispheroid, or rather hemi-ovoid, than that of any of the other fossil turtles brought from Nebraska.

The lateral marginal plates are vertical; the axillary notches are directed outward and downward; the inguinal notches present downward; and the sternum is quite flat, except that its anterior extremity inclines upward.

In both specimens, the costal plates of the carapace had yet been unconnected by suture with the adjoining marginal plates.

The species presents the ordinary or normal number and arrangement of vertebral plates.

Plates of the Carapace.—(Pl. XX. 1.) The first vertebral plate is one and a quarter inch long by three-fourths of an inch broad; the succeeding plates, to the eighth inclusive, are hexahedral; those to the sixth being nearly equal in size; and the tenth transversely rhomboidal plate is three-fourths of an inch long by one and a quarter broad.

The first costal plate is three inches long by one and three-quarters broad, and articulates with the first and second and four-fifths of the third marginal plates.

The nuchal plate comes in contact with the position of the first costal scute at the anterior angle of this, and here measures two and a half inches in breadth.

The pygal plate is vertical, and measures one and a half inch broad.

Plates of the Plastron.—(Pl. XX. 2.) The sternum is truncated anteriorly, and at its posterior extremity is rounded and emarginate.

The entosternal plate is broad, pyriform, and extends for half an inch upon the position of the gular scutes, reaches posteriorly the boundary of the humeral scutes, and is about two inches long and broad.

The episternal plates in the median line are two inches in length.

The hyosternal plates are two inches and eight lines long in the middle, and articulate with the third to the fifth marginal plates inclusive.

The hyposternal plates are two inches two lines long, and articulate with the sixth and seventh marginal plates.

The xiphisternal plates are convex at their margin, and are notched intermediately.

Scutes of the Carapace.—(Pl. XX. 1.) The vertebral scutes, from the second to the fourth inclusive, are hexahedral or quadrate, with bow-shaped sides, and are nearly equal in size. The fifth vertebral scute is prolonged anteriorly, and measures two inches in length.

The nuchal scute is three lines wide, and the pygal scute two and a quarter inches.

The gular scutes together measure two inches in width, and encroach for half an inch upon the ento-sternal plate.

Scutes of the Plastron.—(Pl. XX. 2.) The pectoral scutes are two and three-quarter inches long.

The humeral scutes internally are two-thirds of an inch long, and externally at their anterior border curve forward and outward to the axillæ, and at their posterior border diverge backward and outward in a straight line, so as to join the axillary scute, half of the fourth and the whole of the fifth marginal scutes.

The abdominal scutes are two inches and ten lines long, and join the sixth and seventh marginal scutes and the inguinal scute.

The femoral and caudal scutes, in the median line, measure about one inch and two-thirds long.

MEASUREMENTS.

	Inches.
Length of the sternum	8½
Breadth of the sternum	6⅔
Length of the antero-posterior curve of the carapace	12½
Height of the carapace from the level of the sternum	5
Length of the lateral marginal plates	2¼
Height of latter above the level of the sternum	3

Testudo Oweni, Leidy.

(Pl. XXI., XXIV. Fig. 4.)

Emys Oweni, Leidy: Proc. Acad. Nat. Sci., 1851, v., 327.
Testudo Oweni, Leidy: Proc. Acad. Nat. Sci., 1852, vi., 59; Owen's Rep. of a Geol. Surv. of Wisc., etc., 568.

This species is established upon a nearly entire carapace and plastron. The former has nearly the same degree of convexity and form of that of the Box Tortoise (*Cistudo Carolina*).

The costal plates had not yet united by suture with the marginal plates.

The latter, at the sides of the carapace, are vertically convex, with their upper border elevated two and a half inches above the level of the sternum. Anteriorly and posteriorly they are less inclined than the contiguous dorsal plates.

The sternum is flat, except at its union with the carapace, in which position it is convex, and anteriorly is turned upward, and has its margin angularly convex; and posteriorly it is emarginate.

Plates of the Carapace.—(Pl. XXI. 1.) In the specimen there are ten vertebral plates. The first is one and a half inch long, by ten lines broad. Those succeeding to the eighth inclusive are hexahedral; the second to the fifth are nearly equal in size; those to the eighth successively decrease.

The second vertebral plate articulates with the first and second pairs of costal plates; the third with the second and third; and so on successively to the eighth plate inclusive.

The tenth vertebral plate is fourteen lines long by seventeen broad, and is divided into two nearly equal triangles by the posterior border of the last vertebral scute.

The first costal plate is three inches long by two broad, and articulates with the first to the commencement of the fourth marginal plate.

The nuchal plate is three and a quarter inches broad, and is equal to the first vertebral scute. The pygal plate is twenty-two lines broad.

Plates of the Plastron.—(Pl. XXI. 2.) The entosternal plate is pyriform, and is two inches four lines long and broad. Its anterior extremity borders on the position of the gular scutes, and posteriorly it extends to the humeral scutes.

The anterior margin of the episternal plates is convex. Their length obliquely at the middle is equal to that of the preceding plate.

The hyosternal plates are three and a half inches long from their anterior angle, and they articulate with the third to the angle of the sixth marginal plates inclusive.

The hyposternal plates are two and a half inches long at their middle, are slightly oblique at the posterior margin, and articulate with the sixth and seventh marginal plates.

The xiphisternal plates include an acute notch posteriorly, and are two and a quarter inches long.

The suture between the marginal plates of the carapace and those of the plastron, and the junction of the contiguous scutes from two irregular undulant intersecting lines.

Scutes of the Carapace.—(Pl. XXI. 1.) The second and third vertebral scutes are nearly equal in size, each being two inches seven lines broad, the former two inches long, and the latter one line longer. Their lateral margins are bow-formed, and the anterior margin of the second is nearly straight, while that of the third is convex forward.

The fourth vertebral scute is slightly broader than long, being two inches two lines in the former direction, and two inches one line in the latter. Its lateral margins, also, are bow-formed, and converge behind, and the anterior margin is angular forwards. The nuchal scute is four lines broad.

The gular scutes together are two and a quarter wide, are convex posteriorly, and do not encroach upon the position of the entosternal plate.

Scutes of the Plastron.—(Pl. XXI. 2.) The pectoral scutes are three and a

quarter inches long, and have their posterior border a little behind the axillary notches.

The humeral scutes are about seven and a half lines long where they come in contact, but outwardly expand to two and a half inches. They join the axillary scute, the posterior angle of the fourth, the whole of the fifth, and the lower half inch of the anterior margin of the sixth marginal scutes.

The abdominal scutes are three inches in length, and join the sixth and seventh marginal, and the inguinal scutes.

The length of the femoral scutes is two and a quarter inches, and that of the caudal scutes where they are conjoined, is one inch five lines.

The axillary scute is placed upon the anterior angle of the hyosternal and the postero-inferior margin of the third marginal plates, between the fourth marginal and the humeral scutes.

The inguinal scute rests upon the hyposternal and seventh marginal plates, between the abdominal and seventh and eighth marginal scutes.

MEASUREMENTS.

	Inches.	Lines.
Length of sternum in the median line	10	0
Breadth of sternum at the suture of the hyo- and hyposternal plates	7	0
Estimated length of antero-posterior curve of the carapace	13	6
Length of transverse curve from the level of the sternum	15	6
Height	5	6
Length of the sixth marginal plate	2	6
Height of the upper edge of the lateral marginal plates from the level of the sternum	3	0

This species is respectfully dedicated to Dr. David Dale Owen, of New Harmony, Indiana, whose many contributions to Palaeontology and Geology have rendered him distinguished in science.

Testudo Culbertsonii, Leidy.

(Plates XXII., XXIV. Fig. 2.)

Emys Culbertsonii, Leidy: Proc. Acad. Nat. Sci., 1852, vi., 34.
Testudo Culbertsonii, Leidy: Proc. Acad. Nat. Sci., 1852, vi., 59; Owen's Rep. of a Geol. Surv. of Wisc., etc. 569.

This species is established upon a nearly entire carapace and plastron in the collection of Dr. Owen. The specimen upon one side is a little crushed out of its original form; and it is much larger than that upon which is founded the *Testudo Oweni*, and is relatively less convex and high in comparison with its length and breadth, and also is less abruptly retuse posteriorly.

The sternum in the specimen is concave, indicating a male individual, and anteriorly it does not turn upward.

The costal plates, though in conjunction with the marginal plates, had not yet united by suture.

The lateral marginal plates are vertically convex, and three and a half inches

long in the curve, and became inferior at their lower fourth, but have no salient angle. Anteriorly and posteriorly to the union of the carapace and plastron, the marginal plates are oblique. The line of suture of the two former is undulant, as is also the corresponding line of conjunction of the scutes; the two intersecting each other several times. These lines are less irregular in their course than in *Testudo Oweni*, and on the two sides are nearly parallel. The axillary and inguinal notches present directly downward.

Plates of the Carapace.—(Pl. XXII. 1.) The carapace has eleven vertebral plates. The first of the series is quadrilateral, with convex sides, and is two and a quarter inches long and one and a half broad. The second is octohedral, with alternating long and concave and short and straight sides; or it is quadrilateral, with concave sides and the angles truncated. It is one and a half inch long and one inch and seven lines broad, and articulates with the anterior three pairs of costal plates. The third vertebral plate is quadrilateral, with convex sides, and it is one and a half inch long and one inch ten lines broad, and articulates with the third pair of costal plates.

A similar arrangement to that described of the second and third vertebral plates exists also in the Gopher (*Testudo polyphemus*).

The fourth to the eighth vertebral plate inclusive are hexahedral, of which the fifth is the largest, while the others decrease in succession from the fourth to the last of the number.

The ninth vertebral plate is an accessory to the usual number, is quadrate, with convex sides, and articulates with the eighth pair of costal plates.

The penultimate V-shaped plate incloses one-half of that succeeding, which is one and a half inch long and two and a quarter inches broad.

The first costal plate is five and a quarter inches long by three inches broad, and articulates with three-fourths of the first marginal plate, all of the second, and three-fourths of the third.

The nuchal plate comes in contact with the position of the first costal scute at the anterior angle, in which position it is five and a quarter inches broad, and equal to the first vertebral scute.

Plates of the Plastron.—(Pl. XXII. 2.) The entosternal plate is pyriform, and is three inches five lines long and two lines broader. Its neck extends three-fourths of an inch upon the position of the gular scutes, and its base is about a third of an inch removed from the humeral scutes.

The hyosternal plates are over five inches in length, and articulate with the third to the angle inclusive of the sixth marginal plates.

The hyposternal plates are four inches long at their middle, and articulate with the sixth and seventh marginal plates.

The xiphisternal plates include a notch behind, and in the median line of the sternum are three inches long.

Scutes of the Carapace.—(Pl. XXII. 1.) The second and third vertebral scutes are three inches long; the former three and a half, the latter four inches broad. The sides are bow-shaped, and nearly parallel. The anterior margin of the second is deeply concave; that of the third bow-shaped. The fourth vertebral scute is

three inches three lines broad, and is seven lines longer. It has bow-shaped sides, converging posteriorly, and its anterior margin is angular. The last vertebral scute is prolonged anteriorly as a cup-shaped process.

The nuchal scute is five lines broad, and the pygal scute four and a half inches.

Scutes of the Plastron.—(Pl. XXII. 2.) The gular scutes are acute behind, and encroach upon the position of the entosternal plate.

The pectoral scutes are five and a quarter inches long, and extend posteriorly to the axillary notches.

The humeral scutes are about an inch long, but expand outwardly, and join the axillary and the fourth and fifth marginal scutes.

The abdominal scutes are four and a half inches long at their middle, and join the sixth and seventh marginal and the inguinal scutes.

The femoral scutes are three and a half inches long, and the caudal scutes, where they come into contact, are one and three-quarter inches.

The axillary scute is situated at the outer side of the notch, and rests upon the inferior angle of the hyosternal plate between the humeral and fourth marginal scutes. The inguinal scute rests upon the hyposternal and seventh marginal plates, between the abdominal and seventh and eighth marginal scutes.

MEASUREMENTS.

	Inches.
Estimated length of sternum in the median line	15
Breadth of sternum	11
Estimated length of the antero-posterior curve of the carapace	22
Estimated length of transverse curve	22
Height	6½
Length of sixth marginal plate	3¾
Height of lateral marginal plates above level of the sternum	4

This species is respectfully dedicated to Mr. Thaddeus A. Culbertson, through whose interested zeal so many of the animal remains of Nebraska have been discovered.

Testudo lata, Leidy.

(Plates XXIII., XXIV. Fig. 1.)

Testudo lata, Leidy: Proc. Acad. Nat. Sci., 1851, v., 173; Owen's Rep. of a Geol. Surv. of Wisc., etc., 572.

This species is the largest of any of the turtles brought from Nebraska, and was obtained by Mr. Thaddeus A. Culbertson. The specimen upon which it was established consists of a carapace and plastron broken into two pieces and otherwise much mutilated. A considerable portion of the carapace is lost, and the sternum is crushed inward from its articulation with the former.

The form of the species is very much like *Testudo Culbertsonii,* and it may possibly be the same, though it differs in several of its anatomical details.

In the specimen, the costal plates are united to the marginal plates by close suture.

The lateral marginal plates are vertical at their upper four-fifths, and those anteriorly and posteriorly are oblique.

The sternum appears to have been quite flat, and the axillary and inguinal notches are directed downward.

Plates of the Carapace.—(Pl. XXIII. 1.) The first vertebral plate has convex sides, and has the form of a sugar-loaf; it is two and three-quarter inches long and one inch seven lines broad at its middle.

The second and third, and portions of the fourth and seventh, and the eighth vertebral plates, preserved in the specimen, are hexahedral, and the first two are subequal.

The ninth, or inverted V-shaped vertebral plate, is a little depressed anteriorly to receive the border of the plate in advance.

The tenth, or rhomboidal vertebral plate, is two and three-quarter inches long, and three and a half broad.

The first costal plate is six and three-quarter inches wide and four and a half inches antero-posteriorly, and articulates with the first to the third marginal plates inclusive.

The nuchal plate, as in all the species described, reaches only the anterior angle of the position of the first costal scute, and there measures seven inches in breadth.

Plates of the Plastron.—(Pl. XXIII. 2.) The entosternal plate is pyriform, and is four inches long and three-fourths of an inch broader.

The hyosternal plates are seven and a quarter inches long, and articulate with the marginal plates from the third to the middle of the sixth inclusive.

The hyposternal plates are five and a half inches long, and articulate with the sixth and seventh marginal plates.

The xiphisternal plates, where in contact, measure four inches in length.

Scutes of the Carapace.—(Pl. XXIII. 1.) The second vertebral scute is quadrilateral, and is four inches long and three-fourths of an inch greater in its breadth. The lateral margins are slightly bow-formed and parallel, and the anterior and posterior borders are concave.

The last vertebral scute is prolonged anteriorly into a cup-shaped process, receiving the scute in advance.

Scutes of the Plastron.—(Pl. XXIII. 2.) The gular scutes are angular posteriorly, and encroach for one inch upon the position of the entosternal plate.

The humeral scutes are one and a quarter inch long internally, and outwardly join the axillary and the fourth to the middle of the sixth marginal scute.

The abdominal scutes are five and a half inches long, and join the sixth and seventh marginal and the inguinal scutes.

MEASUREMENTS.

	Inches.
Estimated length of the sternum	21
Breadth of the sternum	15
Estimated length of antero-posterior curve of the carapace	27
Estimated length of transverse curve	27
Height above level of the sternum	8
Length of lateral marginal plates	5

SYNOPSIS

OF THE

GENERA AND SPECIES OF EXTINCT MAMMALIA AND CHELONIA DESCRIBED IN THIS WORK.

MAMMALIA.

UNGULATA PARIDIGITATA.

RUMINANTIA.

POEBROTHERIUM. Hornless; without lachrymal fossæ; auditory bullæ very large and inflated; orbits closed by a post-orbital arch. Lower jaw with an angular apophysis. Dental formula: *in.* $\frac{0?-0?}{4?-4?}$ *c.* $\frac{1?-1?}{0?-0?}$ *p.m.* $\frac{4-4}{4-4}$ *m.* $\frac{3-3}{3-3} = 38?$ True molars composed as in existing ruminants; premolars most like those of the recent Musks; first premolar removed from the others by a hiatus.

POEBROTHERIUM WILSONII. Unique species.

AGRIOCHOERUS. Hornless; without lachrymal fossæ; orbits open behind. Dental formula: *in.* $\frac{3?-3?}{4?-4?}$ *c.* $\frac{1?-1?}{1?-1?}$ *p.m.* $\frac{4?-4?}{3?-3?}$ *m.* $\frac{3-3}{3-3} = 44?$ True molars constructed after the type of those of existing ruminants; premolars with from one to four lobes, modified in form from those of the true molars.

AGRIOCHOERUS ANTIQUUS. Unique species.

OREODON. Hornless; with a sagittal crest; with the pars-squamosa of the temporal bone relatively as well developed as in the Camel; auditory bullæ none; orbits closed behind; very large lachrymal fossæ. Dental formula: *in.* $\frac{3-3}{4-4}$ *c.* $\frac{1-1}{1-1}$ *p.m.* $\frac{4-4}{3-3}$ *m.* $\frac{3-3}{3-3} = 44.$ Teeth of both jaws forming nearly closed rows. True molars constructed after the type of those of existing ruminants; premolars with one or two lobes. Upper canine with a curved, trihedral, pyramidal crown; lower canine with a compressed conoidal crown. Incisors with flattened crowns.

1. OREODON CULBERTSONII. About the size of the Wolf of Pennsylvania.
2. OREODON GRACILIS. About two-thirds the size of the former.
3. OREODON MAJOR? A little larger than *Oreodon Culbertsonii.*

EUCROTAPHUS. Cranium constructed like that of *Oreodon,* except that it possesses large, inflated auditory bullæ. Dental formula: as in *Oreodon?*

1. EUCROTAPHUS AURITUS. Auditory bullæ laterally compressed spheroidal.
2. EUCROTAPHUS JACKSONI. Smaller than the preceding; auditory bullæ mammillary.

ORDINARIA.

ARCHAEOTHERIUM. With a sagittal crest; orbits closed by a post-orbital arch; glenoid articulation transverse. Lower jaw with a basal apophysis as in *Anthracotherium*. Dental formula: *in.* $\frac{?-?}{?-?}$ *c.* $\frac{1?-1?}{1?-1?}$ *p.m.* $\frac{4?-4?}{4?-4?}$ *m.* $\frac{3-3}{3-3}$. Crowns of upper true molars quadrate, with two transverse rows of three conical tubercles or lobes; the lower ones with two transverse pairs of tubercles, of which that antero-internally is subdivided. Last upper premolar bilobed; penultimate upper molar compressed conoidal. Last lower premolar compressed conoidal.

1. Archaeotherium Mortoni. Head about the size of that of the Lion.

2. Archaeotherium robustum. Rather larger than the preceding.

UNGULATA IMPARIDIGITATA.

SOLIPEDIA.

ANCHITHERIUM. With a short sagittal crest; forehead broad and large; orbits large. Dental formula: *in.* $\frac{3-3}{3-3}$ *c.* $\frac{1-1}{1-1}$ *m.* $\frac{7-7}{7-7}$. Molars constructed after the type of those of *Palaeotherium*.

Anchitherium Bairdii. About the size of *Anchitherium aurelianense*.

ORDINARIA.

TITANOTHERIUM. Dental formula as in *Palaeotherium?* Upper molars quadrate, complex, intermediate in form to those of *Palaeotherium* and *Rhinoceros;* their outer side without the double arched ridge characteristic of the former, and without the anterior marginal fold characteristic of the latter. Lower molars like those of *Palaeotherium*, but possessing no inner basal ridge.

Titanotherium Proutii. Unique species.

PALAEOTHERIUM. Dental formula: *in.* $\frac{3-3}{3-3}$ *c.* $\frac{1-1}{1-1}$ *p.m.* $\frac{4-4}{4-4}$ *m.* $\frac{3-3}{3-3} = 44$. Upper molars quadrate, complex; with an external double-arched ridge. Lower molars bilunate; the last trilunate.

Palaeotherium giganteum. Twice the size of the *Palaeotherium magnum;* being the largest species of the genus.

RHINOCEROS. With a nasal or frontal horn, or both, or none. Dental formula: *in.* $\frac{0-0}{0-0}$, or $\frac{1-1}{1-1}$, or $\frac{2-2}{2-2}$ *c.* $\frac{0-0}{0-0}$ *m.* $\frac{7-7}{7-7}$. Upper molars quadrate, complex; with a characteristic antero-external fold. Inferior molars composed of a pair of right angled crescentoid lobes.

1. Rhinoceros occidentalis. With a sagittal crest; frontal horn none; nasal horn? forehead broad and flat. Three-fourths the size of *Rhinoceros indicus*.

2. Rhinoceros Nebrascensis. With a sagittal crest; frontal horn none; nasal horn? Three-fourths the size of *Rhinoceros occidentalis*.

CARNIVORA.

DIGITIGRADA.

MACHAIRODUS. Dental formula: *in.* $\frac{3-3}{3-3}$ *c.* $\frac{1-1}{1-1}$ *m.* $\frac{4-4}{3-3}$. Superior canine long, curved, compressed laterally. Inferior carnassial tooth with a third lobe.

MACHAIRODUS PRIMAEVUS. A little smaller than the American Panther.

CHELONIA.

TESTUDO. Carapace with 10 vertebral plates, 8 pairs of costal plates, and 11 marginal plates each side of a symmetrical nuchal and pygal plate; and 5 vertebral scutes, 4 pairs of costal scutes and 11 marginal scutes each side of a narrow nuchal and a broad undivided pygal scute. First vertebral plate oblong quadrilateral; the succeeding plates to the eighth inclusive hexahedral; penultimate plate inverted V-shaped; the last rhomboidal. Plastron composed of an entosternal and 4 pairs of lateral plates, and furnished with 8 pairs of scutes.

1. TESTUDO NEBRASCENSIS. Small, emydiform. Entosternal plate encroaching upon the position of the gular scutes, but usually not reaching that of the pectoral scutes.

2. TESTUDO HEMISPHERICA. Hemiovoid. Entosternal plate encroaching upon the position of the gular scutes, and reaching that of the pectoral scutes.

3. TESTUDO OWENI. Robust. Entosternal plate not encroaching upon the position of the gular scutes, but reaching that of the pectoral scutes.

4. TESTUDO CULBERTSONII. Large, depressed. Entosternal plate encroaching upon the position of the gular scutes, but not reaching that of the pectoral scutes.

5. TESTUDO LATA. It is possible that this species and the last indicated may be the same. In the specimens upon which these two were proposed, the latter is very much the larger, but the former is immature. In the former, also, the second vertebral plate is octohedral, while in the latter it has the normal hexahedral form, but this variation may be an individual peculiarity only.

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Rhinoceros, 18, 37, 61, 72, 75, 76, 77, 79, 80, 81, 83, 85, 86, 90, 91, 93, 114.
americanus, 72, 76.
incisivus, 79, 80.
indicus, 79, 81, 82, 83, 84, 85, 88, 89, 91, 114.
minutus, 79.
Nebrascensis, 86, 87, 90, 93, 114.
occidentalis, 81, 87, 88, 89, 90, 91, 114.
tichorinus, 91.
Rorqualis australis, 10.
Sargodon, 7.
Sargus, 7.
Stylemys Nebrascensis, 103.
Sus, 18.
americana, 9.
Tapirus, 18.
americanus 9.
Haysii, 9.
mastodontoides, 9.
Telerpeton elginense, 7.
Testudo, 101, 102, 103, 115.
Culbertsonii, 108, 110, 115.
hemispherica, 105, 115.
lata, 110, 115.
Nebrascensis, 103, 115.
Oweni, 106, 108, 109, 115
polyphemus, 103, 109.
Titanotherium, 72, 76, 78, 91, 114.
Proutii, 72, 76, 114.
Trichecus, 10.
virginianus, 10.
Trichecus rosmarus, 10.
Ursus, 95.
americanus, 9.
amplidens, 9.
Zeuglodon brachyspondylus, 8.
cetoides, 8.
macrospondylus, 8.
pygmæus, 8.

EXPLANATION OF THE PLATES.[1]

PLATE I.

All the figures are of the natural size.

Figs. 1–4. *Poebrotherium Wilsoni.*

Fig. 1. View of the right side of the face. The top of the head and the cranium proper are broken away. To the left is represented the angular apophysis, and in the concavity above this is the very large os tympanica. The upper jaw contains the first premolar, separated from the others by a hiatus, the temporary molars, and the permanent true molars. The lower jaw contains the temporary molars and the permanent true molars.

Fig. 2. Upper view of the nasal extremity of the face, exhibiting its great narrowness.

Fig. 3. View of the masticating surfaces of the upper molars of the specimen 1.

Fig. 4. View of the masticating surfaces of the lower molars of the specimen 1.

Figs. 5–10. *Agriochoerus antiquus.*

Fig. 5. View of the right side of the face. The specimen is much mutilated, but the orbit is observed not to be closed by an arch posteriorly. In the upper jaw the inner part of the second premolar of the left side is visible, and succeeding it upon the right side the posterior two premolars and the true molars. In the portion of lower jaw are visible the posterior two premolars and the true molars.

Fig. 6. Inferior view of the upper jaw, exhibiting the triturating surfaces of the molars, five of which are preserved on the right side and six upon the left. The hard-palate is obscured by a mass of very dense matrix, which would endanger the integrity of the specimen to remove.

Figs. 7, 8. Triturating surfaces of the posterior five inferior molars of the right and left sides.

Fig. 9. Triturating surfaces of the first and second true inferior molars of the left side, somewhat worn.

Fig. 10. Triturating surfaces of the posterior two true superior molars of the left side, a little worn, and probably belonging to the same individual as the last specimen.

PLATE II.

Figures of the natural size.

Oreodon Culbertsonii.

Fig. 1. The right side of a much fractured skull with the lower jaw, of an adult, containing the full complement of teeth quite perfect. In the upper jaw are three incisors, the canine, four premolars, and three true molars; in the lower jaw, four incisors, the canine, three premolars, and three true molars.

Fig. 2. Front view of the three upper and four lower incisors of the right side, from the same specimen as the preceding figure.

Fig. 3. The left side of another adult specimen, which is in a comparatively fine state of preservation. It has lost the nasal extremity, post-orbital arch, and zygoma; the latter, however, was entire when the specimen was received, but was afterwards accidentally broken off and lost. The upper jaw contains the seven molars, and the lower jaw the canine and six molars.

[1] All the Plates are drawn directly from Nature, on stone. Plates 1, 2, 3, 8, 9, 10, 11, 13, are by Mr. A. Sonrel, of Woburn, Mass.: Plates 4, 7, 13, 14, 16, 20, 21, 22, 23, 24, by Mr. A. Frey, of Philadelphia: Plates 5, 6, 12, by Mr. A. J. Ibbotson, of Philadelphia: Plates 18, 19, by Mr. F. Schell, of Philadelphia: and Plate 17 by Mr. J. Butler, of Philadelphia.

PLATE III.

Figures of the natural size.

Oreodon Culbertsonii.

Fig. 1. View of the base of a skull containing on both sides all the molars perfect, and on the left side the canine in the same condition. From an adult male individual. The molar teeth are four premolars and three true molars.

Fig. 2. View of the left side of the same specimen as the last, exhibiting the canine and the succeeding series of molars.

Fig. 3. Inner view of a series of inferior molars of the right side, restored from several different individuals. The teeth consist of three premolars and three true molars.

Fig. 4. View of the masticating surface of the same series as the last.

Fig. 5. External view of a right posterior inferior molar, removed from its socket.

Fig. 6. View of the masticating surface of the same tooth as the last.

PLATE IV.

Figures of the natural size.

Figs. 1–5. *Oreodon Culbertsonii.*

Fig. 1. Upper view of the skull, from the same specimen as figure 3, Plate II.

Fig. 2. View of the inion or occipital region, from the same specimen as the preceding.

Fig. 3. View of a specimen upon the left side of the face, exhibiting the orbit and lachrymal depression entire.

Fig. 4. Greater portion of the left side of the lower jaw of a young individual, containing the first premolar, the succeeding two temporary molars, and the permanent true molars, of which the last is only partially protruded.

Fig. 5. View of the triturating surfaces of the premolars and last temporary true molar, from the same specimen as the last.

Fig. 6. *Oreodon major.* View of the triturating surfaces of the superior true molars, of the right side, considerably worn.

PLATE V.

All the figures are of the natural size.

Figs. 1, 2. *Oreodon Culbertsonii.*

Fig. 1. View of the left side of the skull of a young individual. The zygoma, end of the nose, and nearly all the teeth are broken away. In advance of the orbit is observable the large lachrymal depression.

Fig. 2. View of the base of the same specimen as the last. Upon the right side of the jaw all the molars are preserved, consisting of the temporary series and the permanent true molars. The foramina visible at the base of the cranium, proceeding backward on each side, are the rotundum, ovale, lacerum, and condyloideum.

Figs. 3, 4. *Oreodon gracilis.*

Fig. 3. View of the base of the skull of a young animal. The teeth visible on the left side, proceeding backward, are, a fragment of the canine, the two fangs of the first premolar, three succeeding temporary molars, and two permanent true molars. On the right side are preserved the last temporary true molar and the succeeding two permanent true molars. The oblique lines indicate a portion of the matrix, in which the specimen was originally imbedded.

Fig. 4. Superior view of the same specimen as the last. It presents a remarkable degree of flatness of the forehead.

PLATE VI.

All the figures are of the natural size.

Figs. 1–7. *Oreodon gracilis.*

Fig. 1. Upper view of a broken skull.

Fig. 2. Base view of the same specimen. On the right side the jaw contains entire the last premolar and all the true molars of the permanent series.

Fig. 3. View of the right side of the same specimen as the last.

Fig. 4. View of the left side of a face and lower jaw of another adult specimen. The upper jaw exhibits the last two molars, and the lower jaw the last premolar and all the true molars. The orbit is entire.

Fig. 5. View of the masticating surfaces of the lower molars of the specimen last indicated.

Fig. 6. View of the left side of the skull and lower jaw of a young individual, being the same specimen represented in Figs. 3, 4, Plate V. The orbit is nearly entire. The upper jaw exhibits a series of the first premolar restored, the three temporary molars, and the anterior two permanent true molars. The lower jaw contains two temporary molars and the succeeding two permanent true molars.

Fig. 7 represents the masticating surfaces of the inferior teeth last mentioned.

Figs. 8–11. *Oreodon Culbertsonii.*

Fig. 8. Masticating surfaces of the inferior posterior five molars of the left side, very much worn.

Fig. 9. Inner view of the same teeth as those last indicated.

Fig. 10. Fragment of the lower jaw of the right side of a young animal. It contains the broken canine, and the entire last temporary molar and the succeeding two permanent true molars.

Fig. 11. Outer view of the same specimen as the last.

PLATE VII.

Figures all the size of nature.

Figs. 1–3. *Eucrotaphus auritus.*

Fig. 1. View of the left side of a portion of the cranium, exhibiting the pars squamosa and the parietal bone.

Fig. 2. Upper view of the same specimen.

Fig. 3. View of the base of the same specimen, exhibiting the large ossa tympanica, portions of the glenoid articulations, and the occipital and sphenoidal bodies.

Figs. 4–6. *Eucrotaphus Jacksoni.*

Fig. 4. View of the right side of a portion of the cranium, exhibiting the pars squamosa, the post glenoid tubercle, the meatus auditorius externus, and part of the parietal bone.

Fig. 5. Upper view of the same specimen as the last. The parietal crest is broken away.

Fig. 6. View of the base of the same specimen. It exhibits one os tympanica with its superficies broken off, one glenoid articulation, and the occipital and sphenoidal bodies.

PLATE VIII.

Figures of the natural size.

Archaeotherium Mortoni.

Fig. 1. View of the base of the skull of a young animal. The deciduous teeth had not yet been shed, and only the first two permanent true molars had protruded. Upon the left side are exhibited the last two permanent premolars, exposed by breaking away deciduous teeth occupying a corresponding position; the first two permanent true molars, which are in place; and the last molar, which was exposed by breaking away the bone. Upon the right side are exhibited the last two deciduous molars, succeeded by the three permanent true molars.

In the specimen, a large mass of matrix occupies the inner surface of the right zygoma, which is allowed to remain so as to give strength to the latter.

Fig. 2. Fragment of the lower jaw of the right side, exhibiting the basal apophysis, and also presenting to view the greater portion of the last temporary molar, beneath which is exposed the last permanent premolar, and posterior to it the protruded first permanent true molar.

PLATE IX.

Archaeotherium Mortoni. Figures 1 to 3 are half the diameter of nature, and the remaining figures are of the natural size.

Fig. 1. View of the right side of the skull. The orbital entrance is entire; and in the upper jaw the posterior two temporary molars and the anterior two permanent molars are seen. The dotted line represents the upper part of the face restored from another specimen.

Fig. 2. Upper view of the same specimen represented in figure 1. The ossa nasi are represented, in dotted lines, from another specimen.

Fig. 3. View of the left side of a facial fragment, from an old individual, containing the posterior two permanent promolars.

Fig. 4. View of the triturating surfaces of the teeth represented in figure 3.

Fig. 5. View of the triturating surfaces of the anterior two permanent true molars of the left side of the upper jaw; from an adult individual.

PLATE X.

Figs. 1–7. *Archaeotherium Mortoni.* All the figures of the natural size except 6 and 7.

Fig. 1. Outer view of the last two premolars and the true molars of the left side of the upper jaw, from the same specimen as Plate VIII., figure 1.

Fig. 2. Outer view of the last premolar and the true molars of the left side of the lower jaw.

Fig. 3. View of the masticating surfaces of the same teeth represented in figure 2.

Fig. 4. Inner view of the last premolar of the left side of the lower jaw; from the same specimen represented in figure 2.

Fig. 5. Inner view of the penultimate premolar of the left side of the upper jaw; from the same specimen represented in figure 1.

Fig. 6. Half the diameter of nature. View of the inion or occipital region. Upon the right of the figure, when placed in proper position, the large infundibular expansion of the root of the zygomatic process is observed.

Fig. 7. Half the diameter of nature. Inner view of the angular portion of the right side of the lower jaw. Near its middle the entrance to the dental canal is observable.

Figs. 8–13. *Archaeotherium robustum.* All the figures of the natural size.

Fig. 8. Outer view of the crown of a canine.

Fig. 9. Anterior view of the same specimen as the preceding.

Fig. 10. View of the triturating surface of a fragment of an inferior second true molar of the left side.

Fig. 11. View of the outer surface of the same specimen represented in figure 10.

Fig. 12. View of the triturating surface of a fragment of an inferior last true molar of the left side.

Fig. 13. View of the inner surface of the same specimen represented in figure 12.

Figs. 14–21. *Anchitherium Bairdii.* All the figures are of the natural size.

Fig. 14. Outer view of the posterior five inferior molar teeth of the left side. The last of the series has lost its hinder lobe.

Fig. 15. View of the masticating surface of the posterior three inferior molars of the left side. From an older individual than the preceding specimen.

Fig. 16. Outer view of an unworn inferior molar of the right side.

Fig. 17. Inner view of the same specimen as figure 16.

Fig. 18. Outer view of the condyle of the left side of the lower jaw.

Fig. 19. Posterior view of the same specimen as the preceding.

Fig. 20. View of the occipital region.

Fig. 21. View of the base of a skull. The jaw yet contains on both sides the last two molars nearly perfect.

PLATE XI.

All the figures are of the natural size.

Anchitherium Bairdii.

Fig. 1. View of the left side of a skull, with the zygoma and fore-part of the face broken away. In the jaw may be observed the posterior two molars entire.

Fig. 2. Upper view of the same specimen as the last.

Fig. 3. Masticating surfaces of all the right superior molar teeth except the first, which is small, and in the specimen is broken away.

Fig. 4. Outer view of the same specimen as the last. The surface of the teeth is much injured from the influence of the weather.

Fig. 5. Portion of the right side of the lower jaw attached to a mass of matrix. It contains the posterior two molar teeth.

Fig. 6. Inner view of a portion of the right side of the lower jaw containing the posterior five molar teeth. From the same specimen as figure 14, Plate X.

Fig. 7. View of the masticating surfaces of the latter-mentioned teeth.

Fig. 8. View of the masticating surfaces of six inferior molars of the left side.

PLATE XII.

Figures half the diameter of Nature.

Rhinoceros occidentalis.

Fig. 1. View of the base of the skull. The left zygoma is preserved nearly entire, and upon the same side of the jaw all the molars except the first, which is, however, whole upon the right side. A portion of the left occipital condyle remains; and in advance of it may be observed the anterior condyloid foramen, the mastoid process, the post-glenoid process, and the glenoid articulation.

Fig. 2. View of the left side of the skull. The face is much mutilated, but the form of the orbit is comparatively well preserved. The zygoma is almost entire, and posterior to its root is observed the meatus auditorius, formed between the post-glenoid and mastoid processes. By the restoration of the first tooth of the series, all the molars are exhibited quite perfect.

PLATE XIII.

Figs. 1–4. Half the diameter of nature; the remaining two of the natural size.

Rhinoceros occidentalis.

Fig. 1. View of the top of the skull, from the same specimen as Plate XII.

Fig. 2. Fragment of the left side of the lower jaw containing the last two molars, viewed from without.

Fig. 3. Fragment of the left side of the lower jaw, containing the three molars anterior to the last.

Fig. 4. View of the triturating surfaces of the teeth, from the same specimen as the last.

Figs. 5, 6. Outer view of two inferior, slightly worn, molars of the right side.

PLATE XIV.

Rhinoceros Nebrascensis.

Figs. 1, 2. Two-thirds the diameter of nature. View of the left side of a much mutilated face and lower jaw. In the upper jaw are seven molar teeth, the triturating surfaces of which, from the same specimen, are represented of the natural size in Fig. 3, Plate XV. The lower jaw contains six molars entire.

Fig. 3. The size of nature, represents the triturating surfaces of the teeth last mentioned, from the same specimen.

Figs. 4–8. Different views of superior molars, which had not yet protruded from the jaws, and therefore were entirely unworn. Of the natural size.

Fig. 4. External view of the anterior four molars of the left side.

Fig. 5. View of the triturating surfaces of the same teeth.

Fig. 6. Internal view of the same teeth.

Fig. 7. View of the anterior side of the third right superior molar.

Fig. 8. View of the posterior side of the same specimen as the last.

Fig. 9. Triturating surfaces of the teeth from the same specimen represented in the succeeding figure. Natural size.

Fig. 10. Fragment of the left side of the lower jaw of a very young animal, viewed upon its outer side and exhibiting the last temporary molar and the first succeeding permanent molar.

Fig. 11. One-half the diameter of nature. View of the forehead taken from the same specimen as figure 1.

Fig. 12. Two-thirds the diameter of nature. View of the inion or occipital region, represented from the same specimen as Figs. 1, 2, Plate XV.

Fig. 13. View of the triturating surfaces of the entire series of the superior molars of the right side, from a different individual from any other indicated. Natural size.

Fig. 14. Fragment of an upper jaw of the right side of a young animal, exhibiting the triturating surfaces of the posterior three temporary molars. Natural size.

PLATE XV.

Rhinoceros Nebrascensis.

Figs. 1, 2. Two-thirds the diameter of nature.

Fig. 1. View of the right side of a skull, with the top broken away its whole length. The specimen belonged to a very old individual, as the molar teeth are nearly worn away to the fangs.

Fig. 2. View of the base of the skull from the same specimen as the last. The characteristic enamelled triturating surfaces of the molars are entirely obliterated.

Fig. 3. The size of nature. It represents the triturating surfaces of the superior molars of the left side.

PLATE XVI.

Titanotherium Proutii.

Figs. 1, 2. One-third the diameter of nature.

Fig. 1. A portion of the right side of the lower jaw, containing the last two and part of the first molar.

Fig. 2. A portion of the left side of the lower jaw of a second and smaller individual, containing the three true molars and the fangs of that in advance.

Fig. 3. One-half the diameter of nature. View of the triturating surface of the true molars, from the same specimen as figure 2.

Figs. 4–7. Two-thirds the diameter of nature.

Figs. 4, 5. Fragment of a left posterior superior molar. Fig. 4. Outer view of the entire portion of the fragment. Fig. 5. View of the masticating surface of the same fragment. This last presents the external anterior cusp with two pits at its base, and the large internal conical lobe.

Figs. 6, 7. Fragment of a superior true molar. Fig. 6. Inner view. Fig. 7. Triturating surface of the same specimen, presenting a large conical lobe, with portion of an enamelled pit at the outer side of its base.

Figs. 8–12. The size of nature.

Figs. 8–10. A second? inferior molar of the left side. Fig. 8. The triturating surface. Fig. 9. The outer view. Fig. 10. The inner view, which is a vertical plane.

Figs. 11, 12. An inferior canine tooth, the size of nature. Fig. 11. Outer view. Fig. 12. Inner view.

PLATE XVII.

All the figures of the natural size, except 8–10, which are two-thirds the diameter.

Figs. 1–10. *Titanotherium Proutii.*

Figs. 1–3. A superior premolar. Fig. 1. Inner view. Fig. 2. Outer view. Fig. 3. View of the triturating surface.

Fig. 4. View of the triturating surface of another superior premolar.

Figs. 5, 6. Fragment of a superior premolar. Fig. 5. View of the triturating surface. Fig. 6. Inner view.

Fig. 7. View of the triturating surface of a fragment of a superior premolar.

Figs. 8–10. A last posterior inferior molar of the left side. Fig. 8. Outer view. Fig. 9. View of the triturating surface. Fig. 10. Inner view.

Figs. 11–13. *Palaeotherium giganteum.* Views of three fragments of as many superior molar teeth; being single external lobes seen upon their outer face.

PLATE XVIII.

Figures of the natural size.

Machairodus primaevus.

Fig. 1. View of the right side of a skull, with the lower jaw. The symphysis of the latter, upper incisors, and zygoma are broken away. The upper jaw presents a portion of the canine, and the second to the last molar inclusive; and in the lower jaw the first and a portion of the second molars are visible.

Fig. 2. Superior view of the right half of the same specimen as the preceding.

Fig. 3. View of the left side of the lower jaw, containing the three molars and a portion of the upper jaw, exhibiting the second molar, from the same specimen as the preceding.

Fig. 4. Outer view of the right inferior canine, which was attached to the mass of matrix adhering to the preceding specimen.

Fig. 5. Front or anterior view of the same tooth.

PLATE XIX.

Figures two-thirds the diameter of nature.

Testudo Nebrascensis.

Fig. 1. Dorsal view of the carapace.

Fig. 2. Lateral view of the carapace.

Fig. 3. Inferior view of the sternum.

PLATE XX.

Figures half the diameter of nature.
Testudo hemispherica.
Fig. 1. Dorsal view of the carapace.
Fig. 2. View of the sternum.

PLATE XXI.

Figures half the diameter of nature.
Testudo Oweni.
Fig. 1. Dorsal view of the carapace.
Fig. 2. View of the sternum.

PLATE XXII.

Figures one-third the diameter of nature.
Testudo Culbertsonii.
Fig. 1. Dorsal view of the carapace.
Fig. 2. View of the sternum.

PLATE XXIII.

Figures one-fourth the diameter of nature.
Testudo lata.
Fig. 1. Dorsal view of the carapace.
Fig. 2. View of the sternum.

PLATE XXIV.

Fig. 1. One-fourth the diameter of nature; the remaining figures one-third.
Fig. 1. View of the left side of the carapace of *Testudo lata.*
Fig. 2. View of the left side of the carapace of *Testudo Culbertsonii.*
Fig. 3. View of the left side of the carapace of *Testudo hemispherica.*
Fig. 4. View of the left side of the carapace of *Testudo Oweni.*

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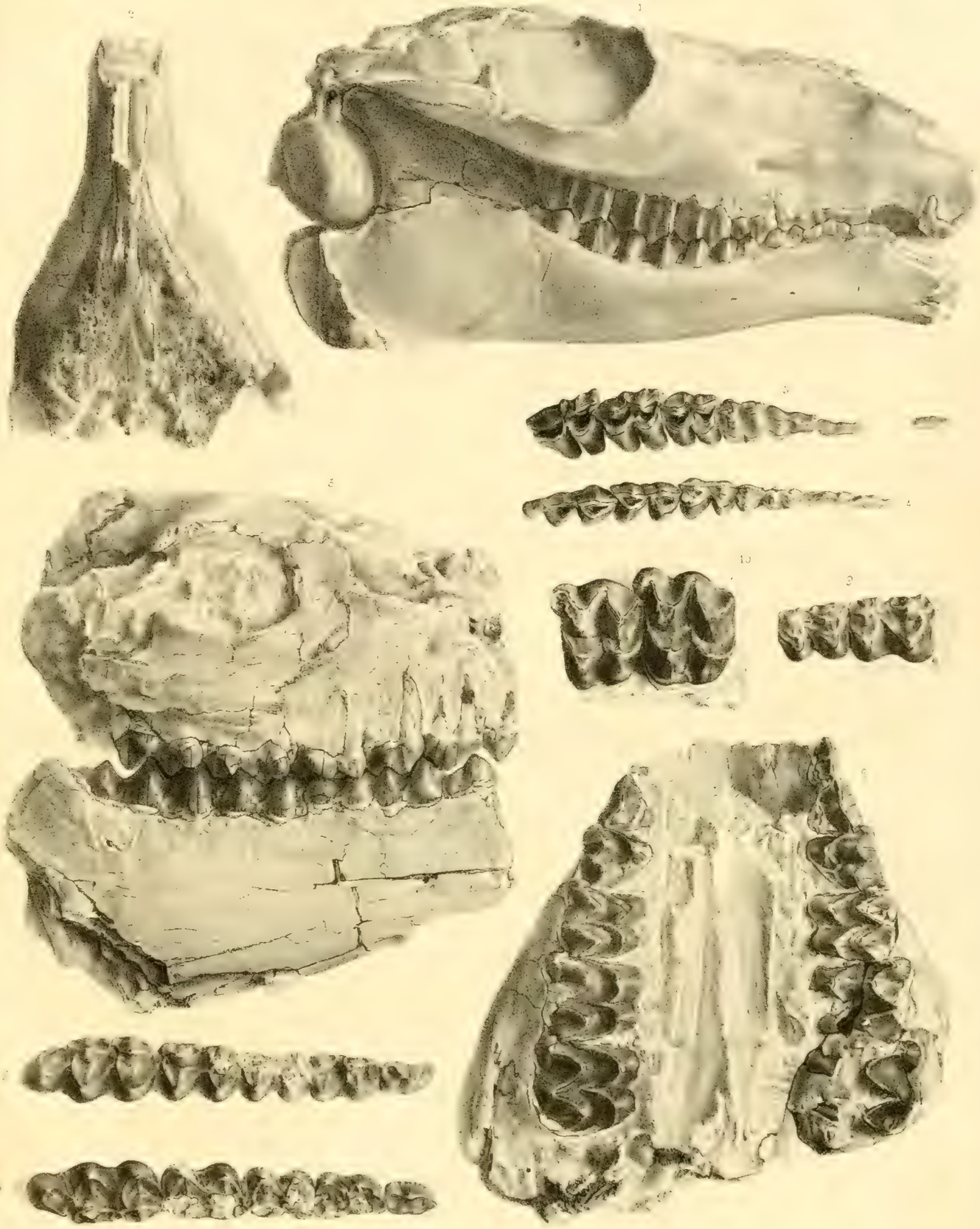

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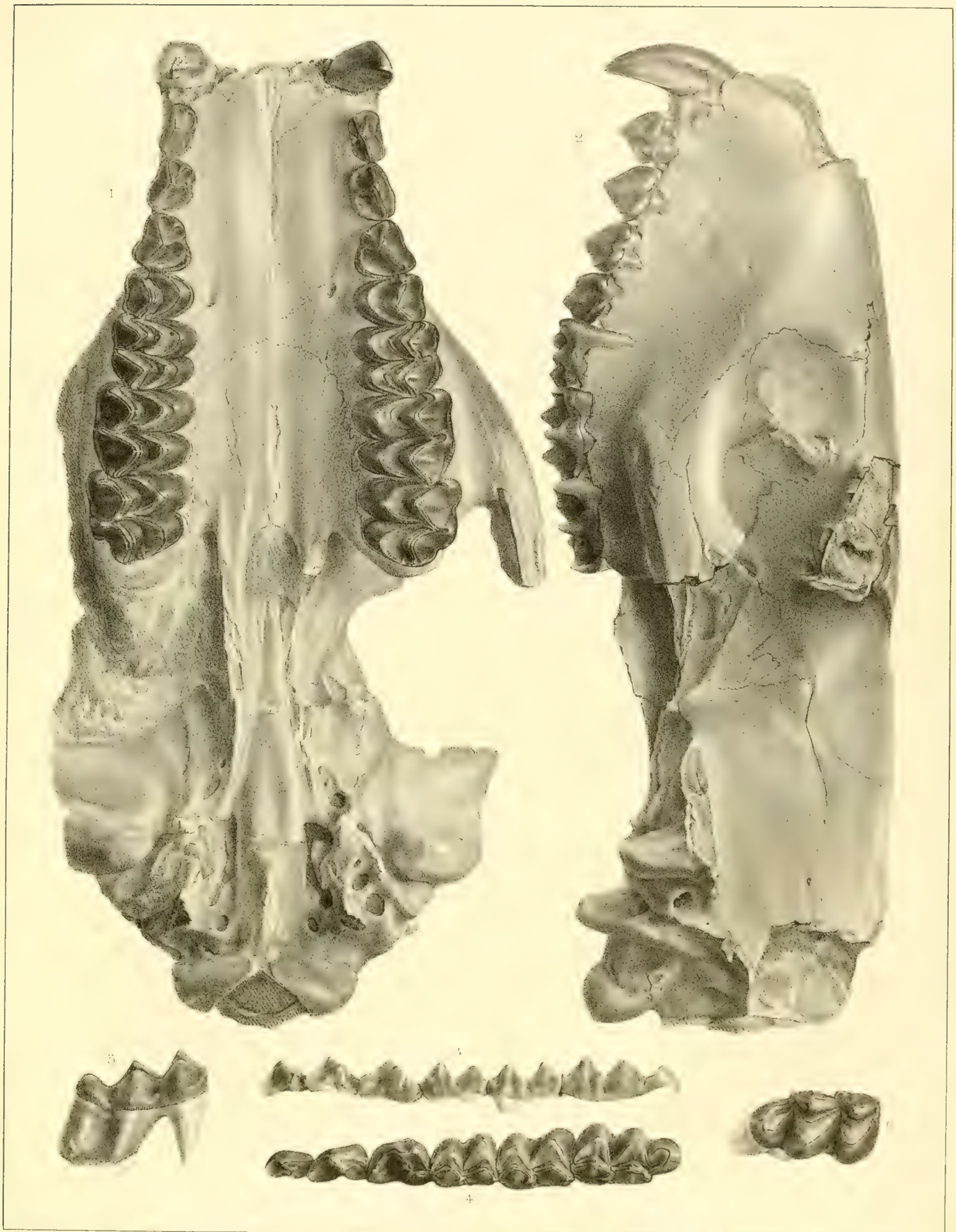
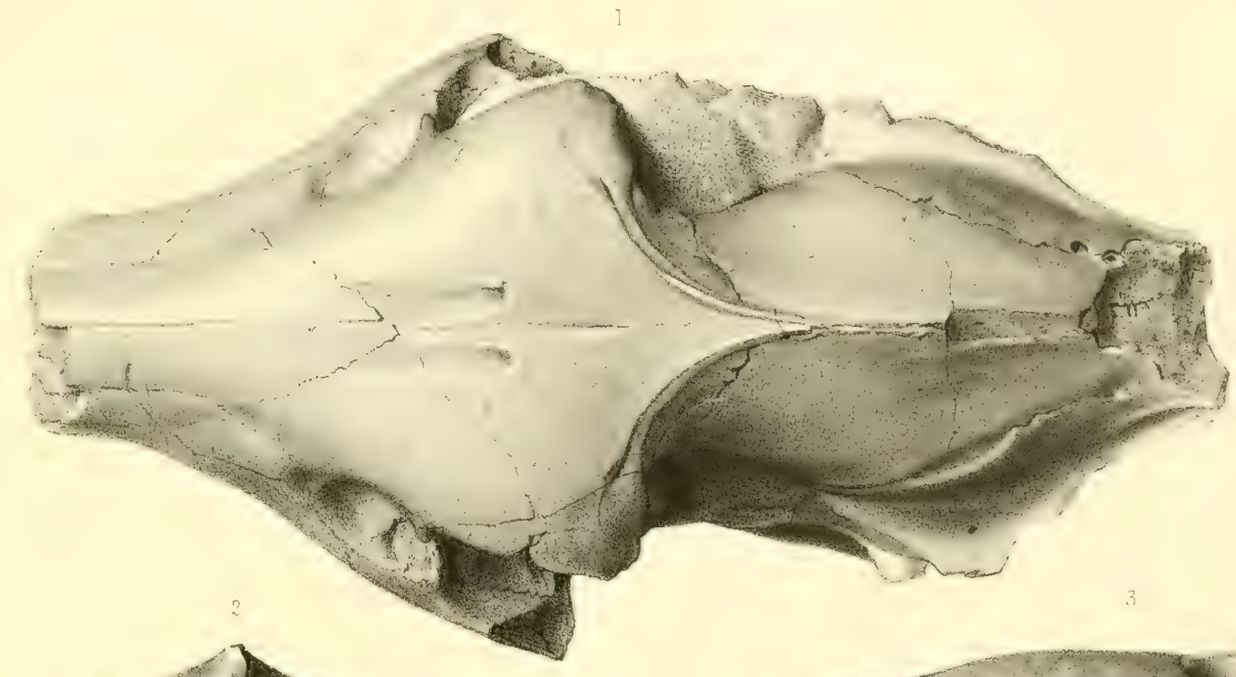
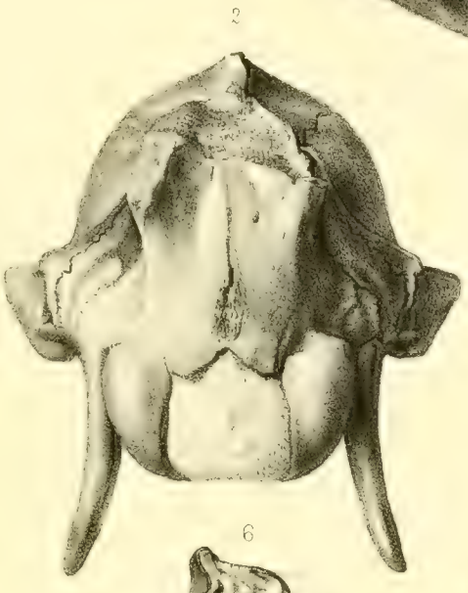
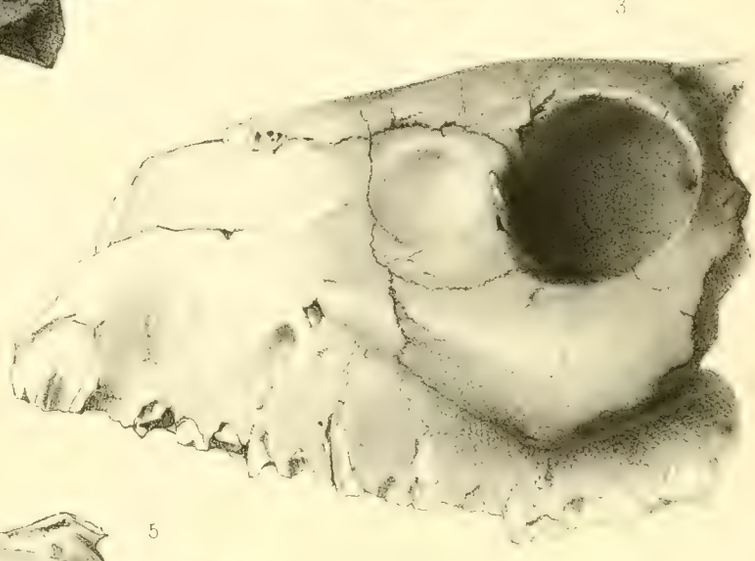
1-4. POEBROTHERIUM WILSONII, Leidy. 5-10. AGRIOCHOERUS ANTIQUUS. Leidy



OREODON CULBERTSONII, Leidy







A. Frey Del.

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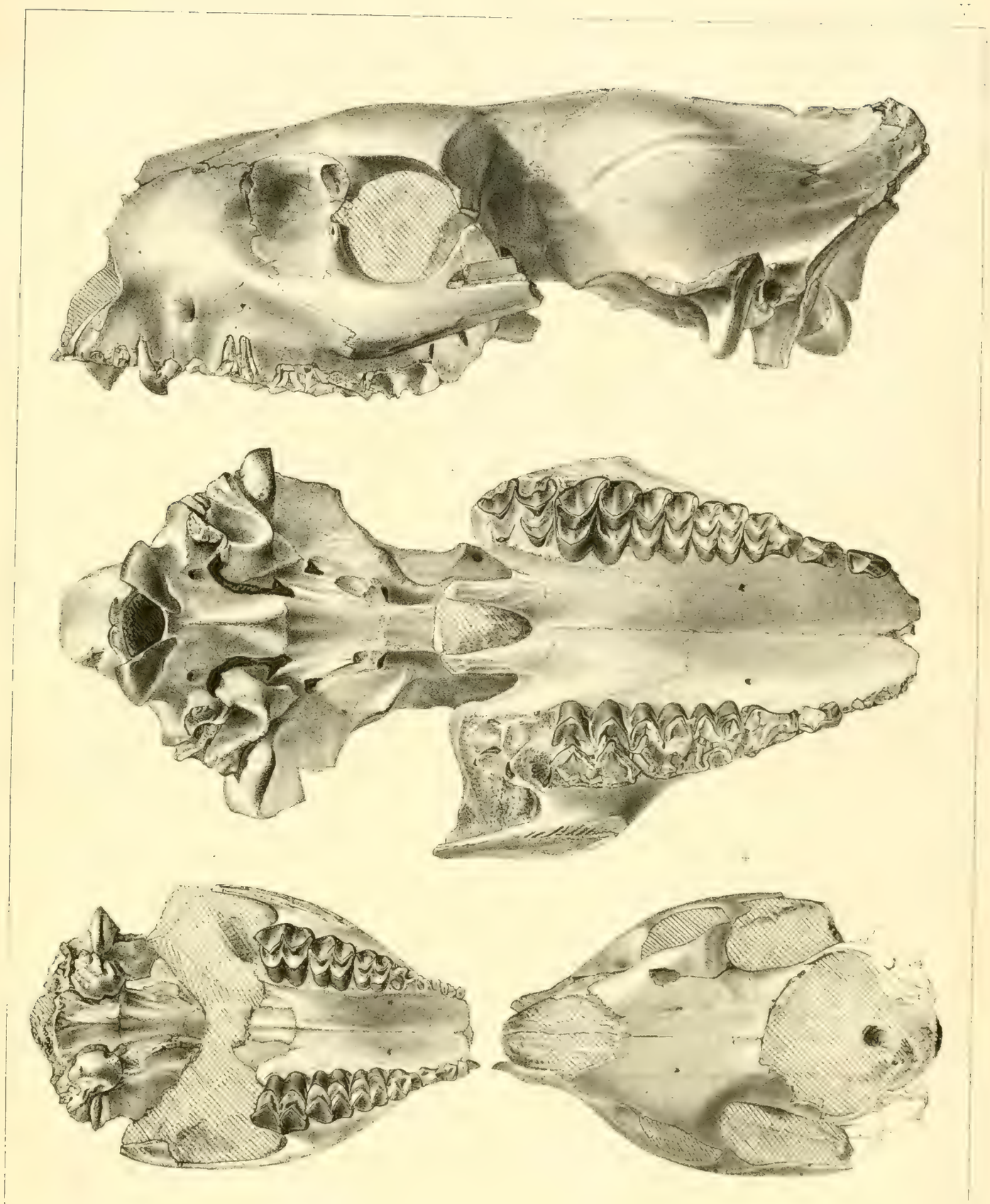
1-5, OREODON CULBERTSONII, Leidy.

6. OREODON MAJOR, Leidy.



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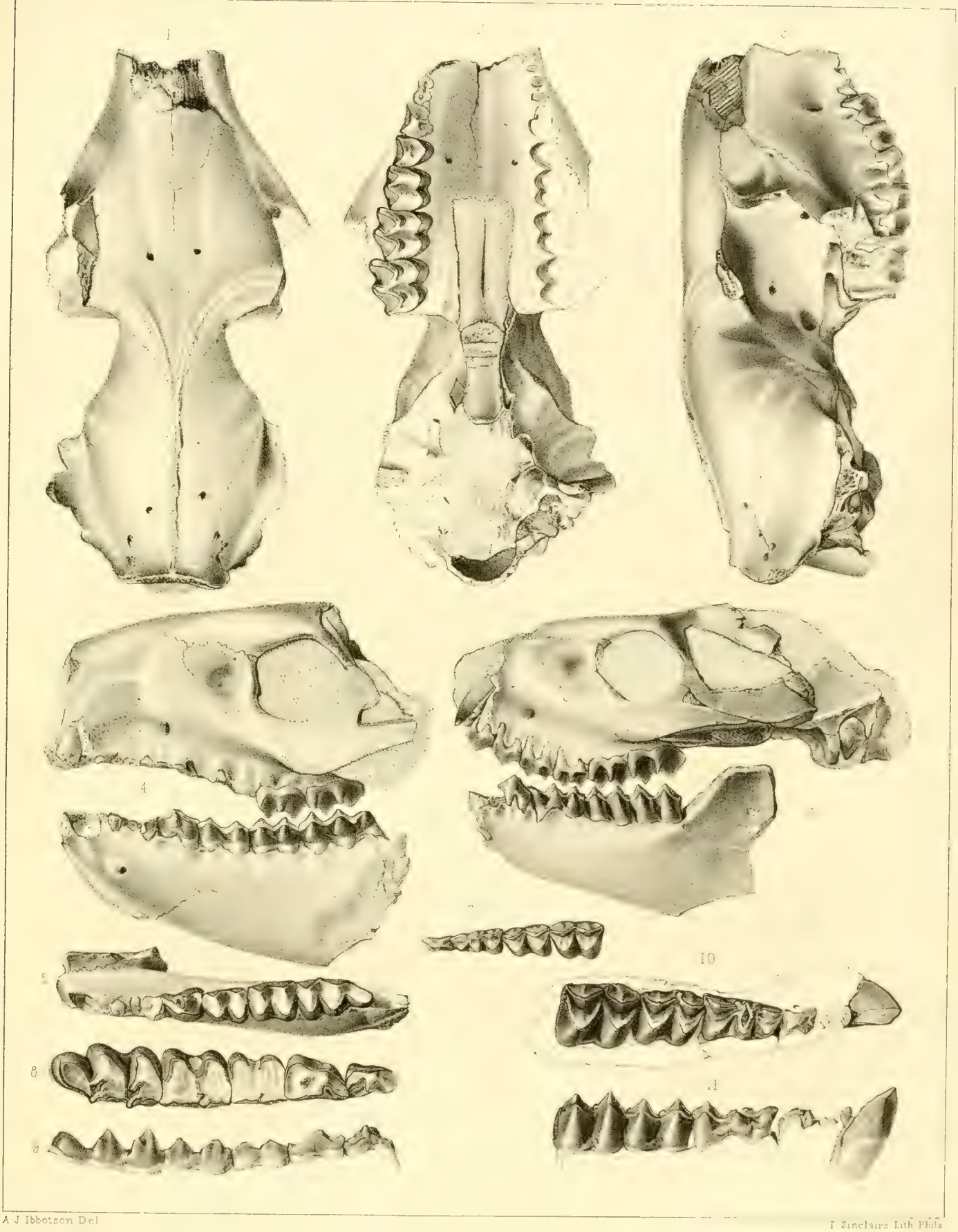

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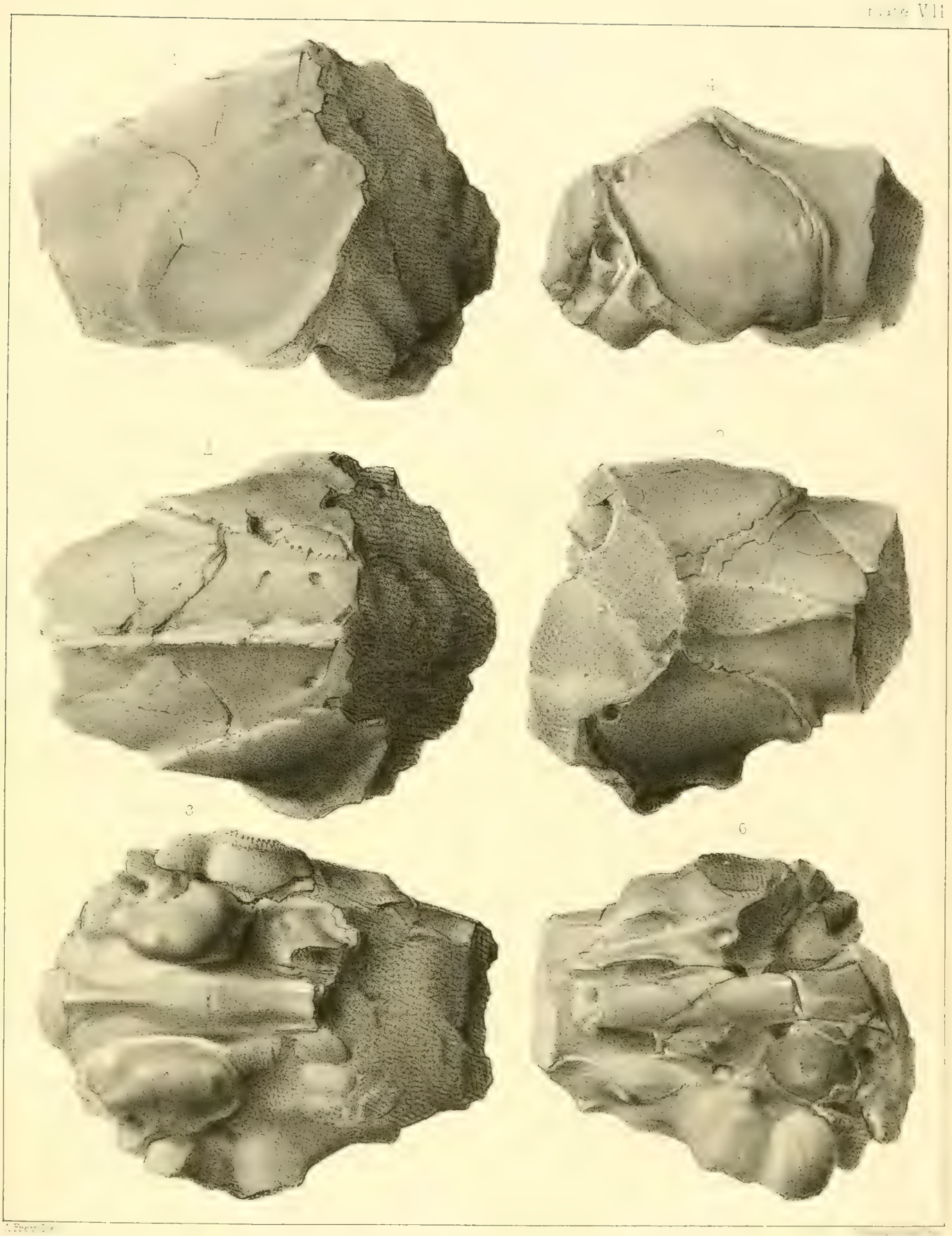
1–7 OREODON GRACILIS, Leidy.

8–11 OREODON CULBERTSONII, Leidy



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4-6, EUCROTAPHUS JACKSONI, Leidy.

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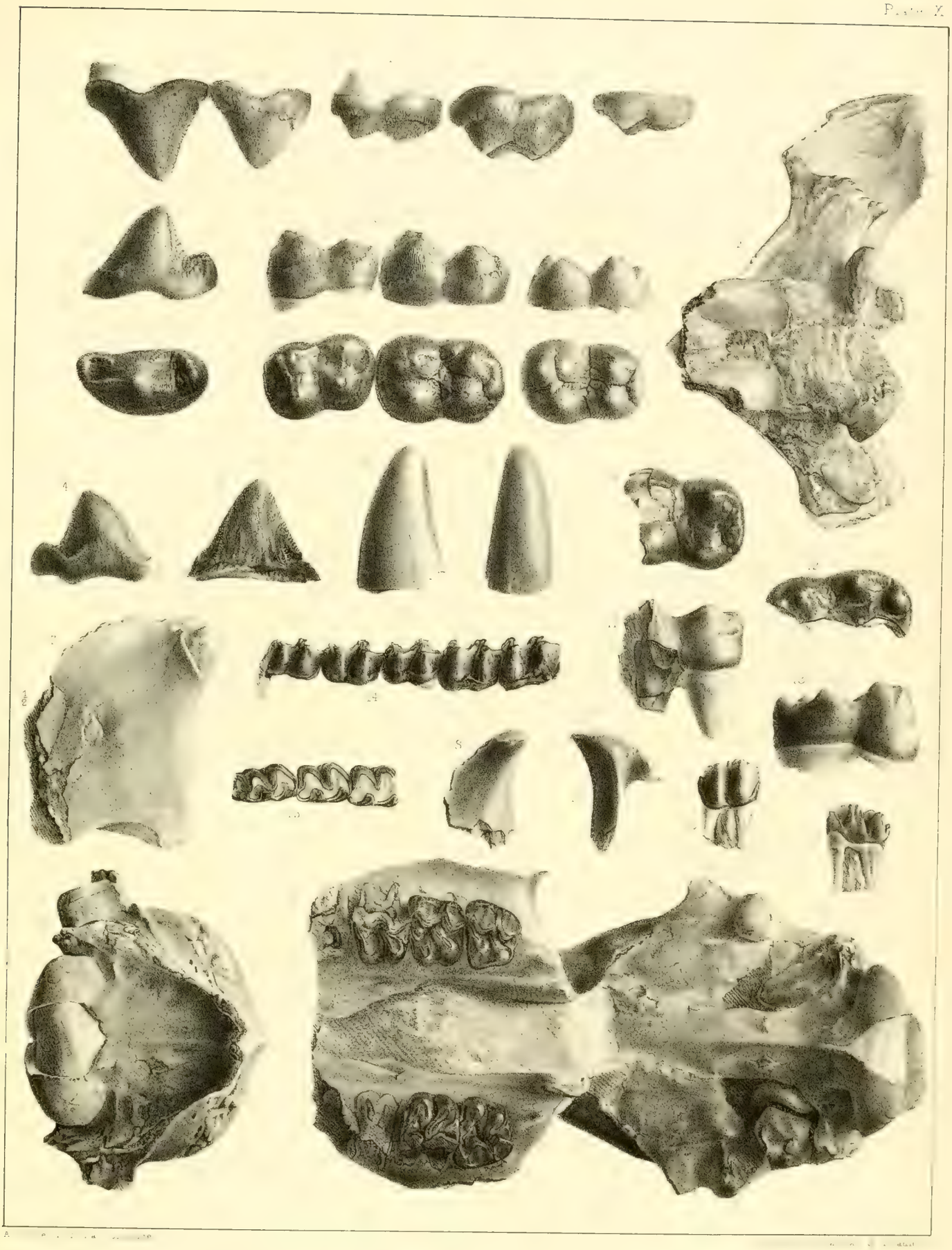
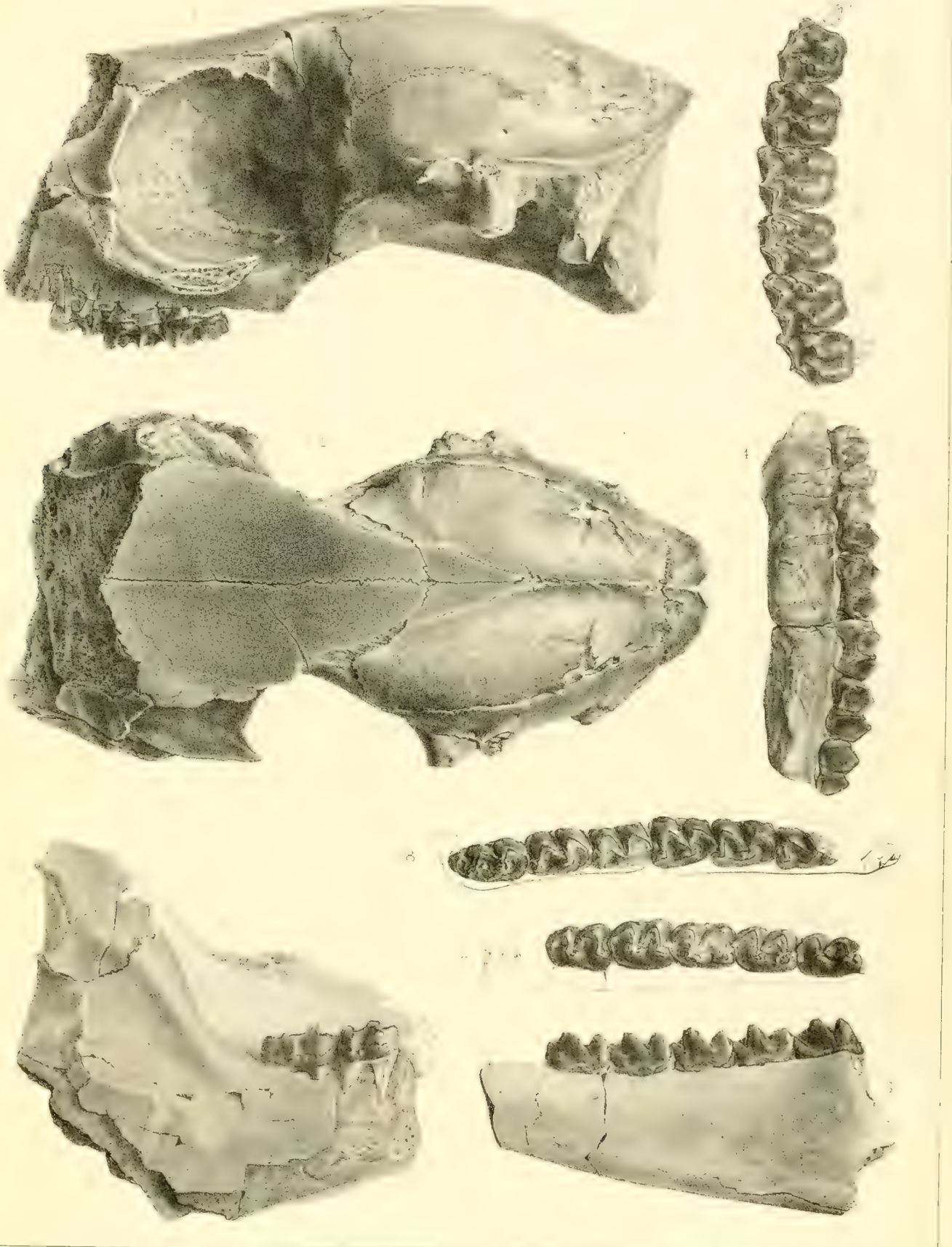
ARCHAEOTHERIUM MORTONI, Leidy



1-7. ARCHAEOTHERIUM MARTINI, Leray. 8-13. A. ROBUSTUM Leray.
14-21. ANCHITHERIUM BAIRDII Leray.



A. Sonrel on stone from nat

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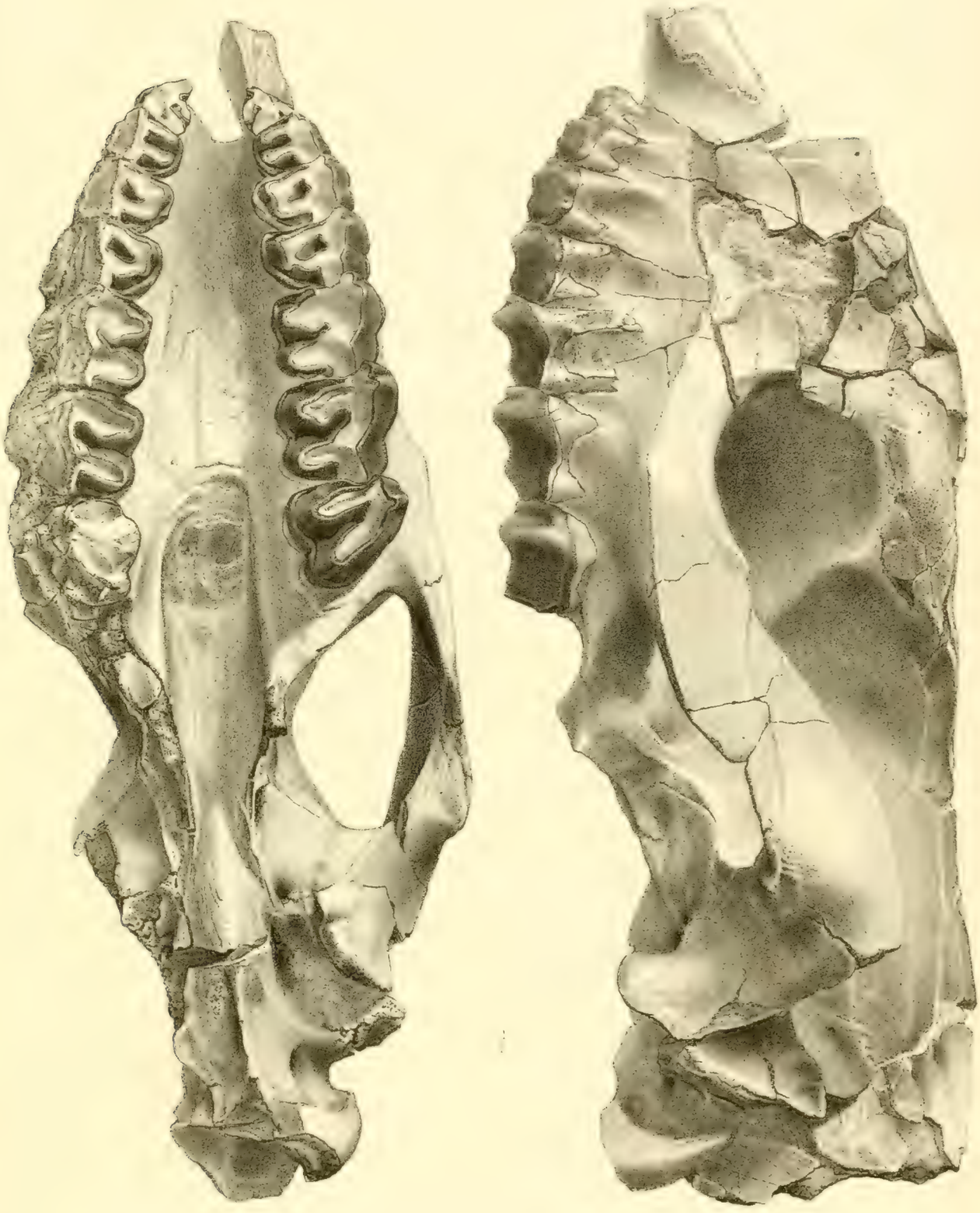
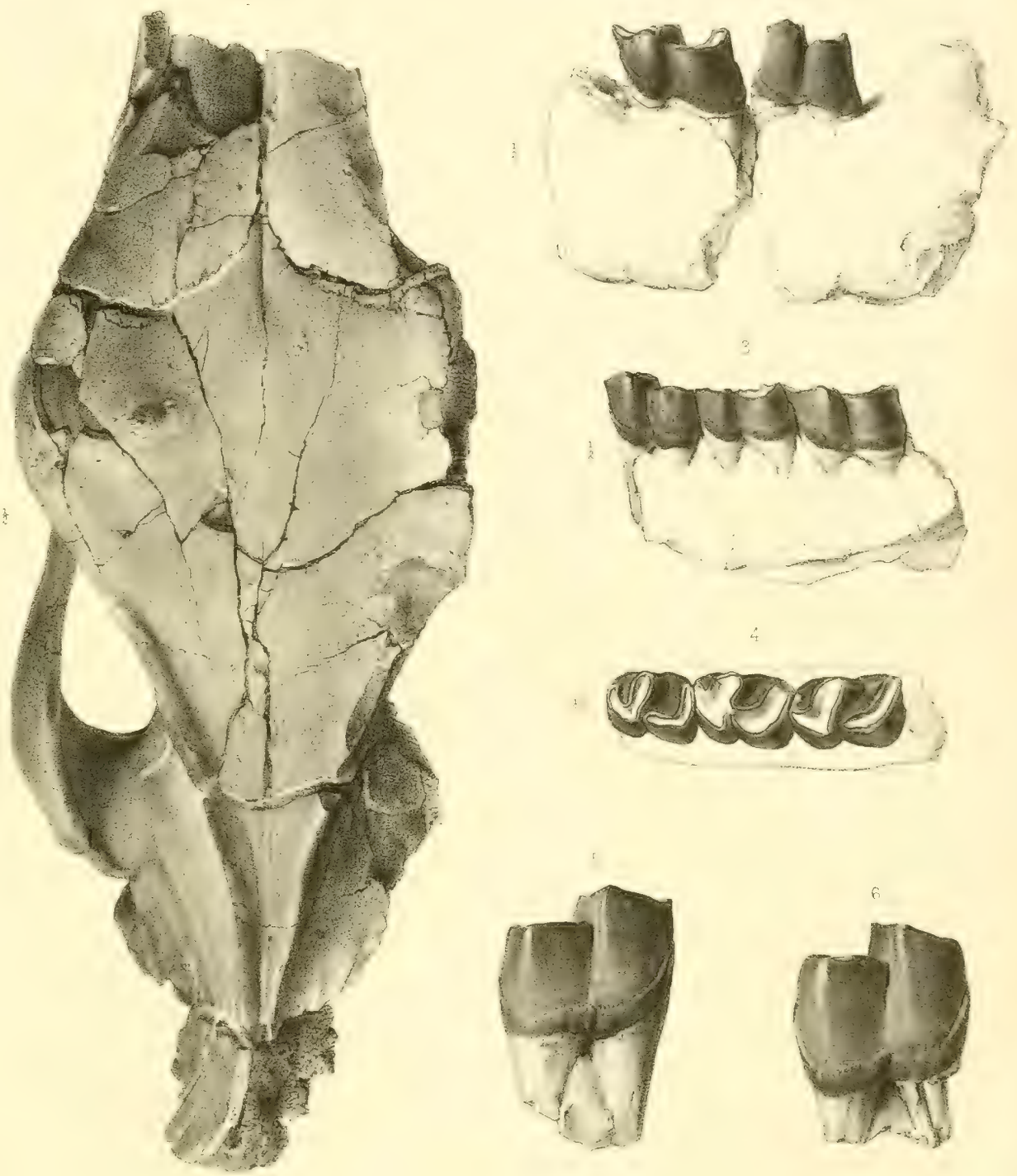
ANCHITHERIUM BAIRDII, Leidy

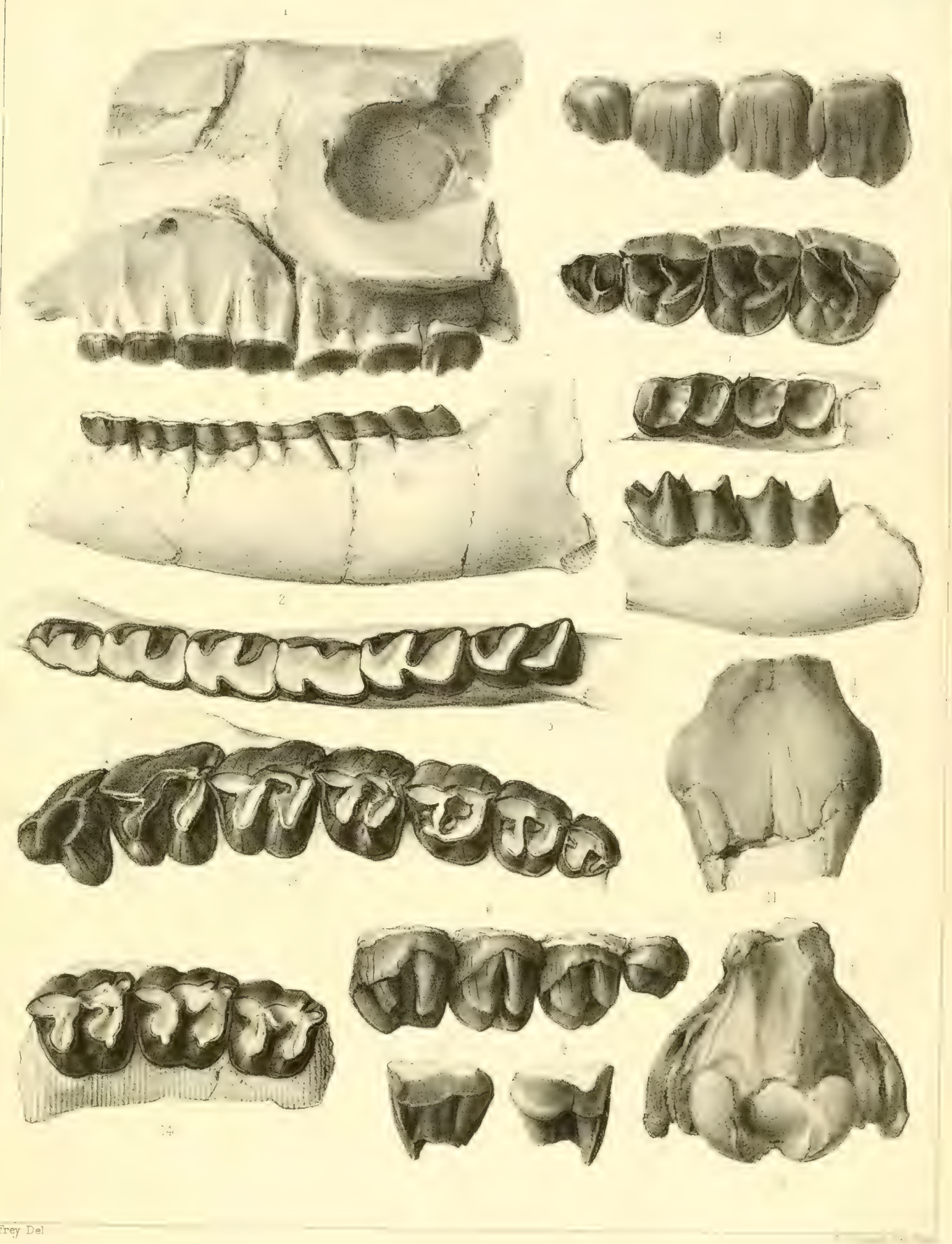




A. Frey, Del.

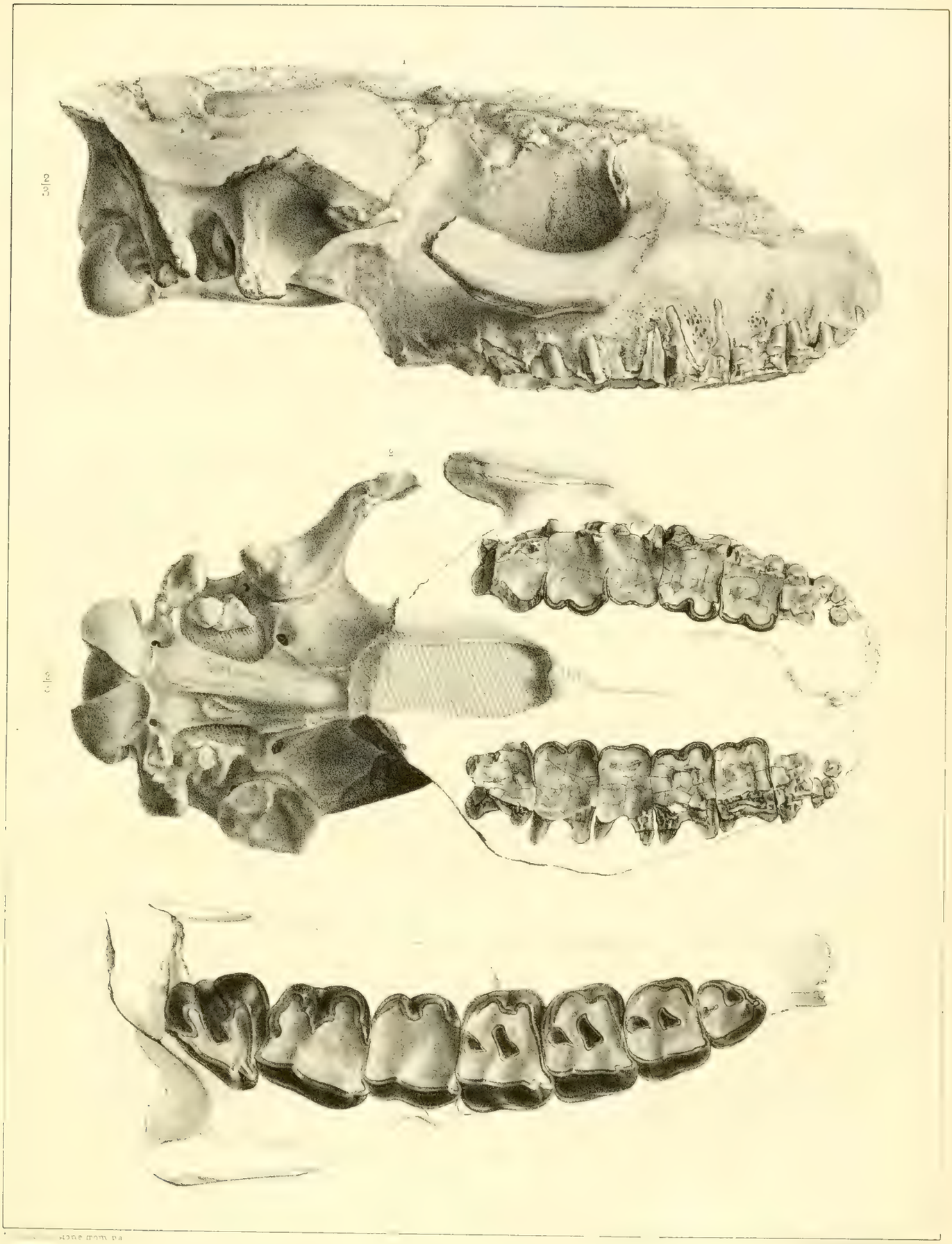
T. Sinclair's Lith. Phila.

RHINOCEROS OCCIDENTALIS, Leidy.

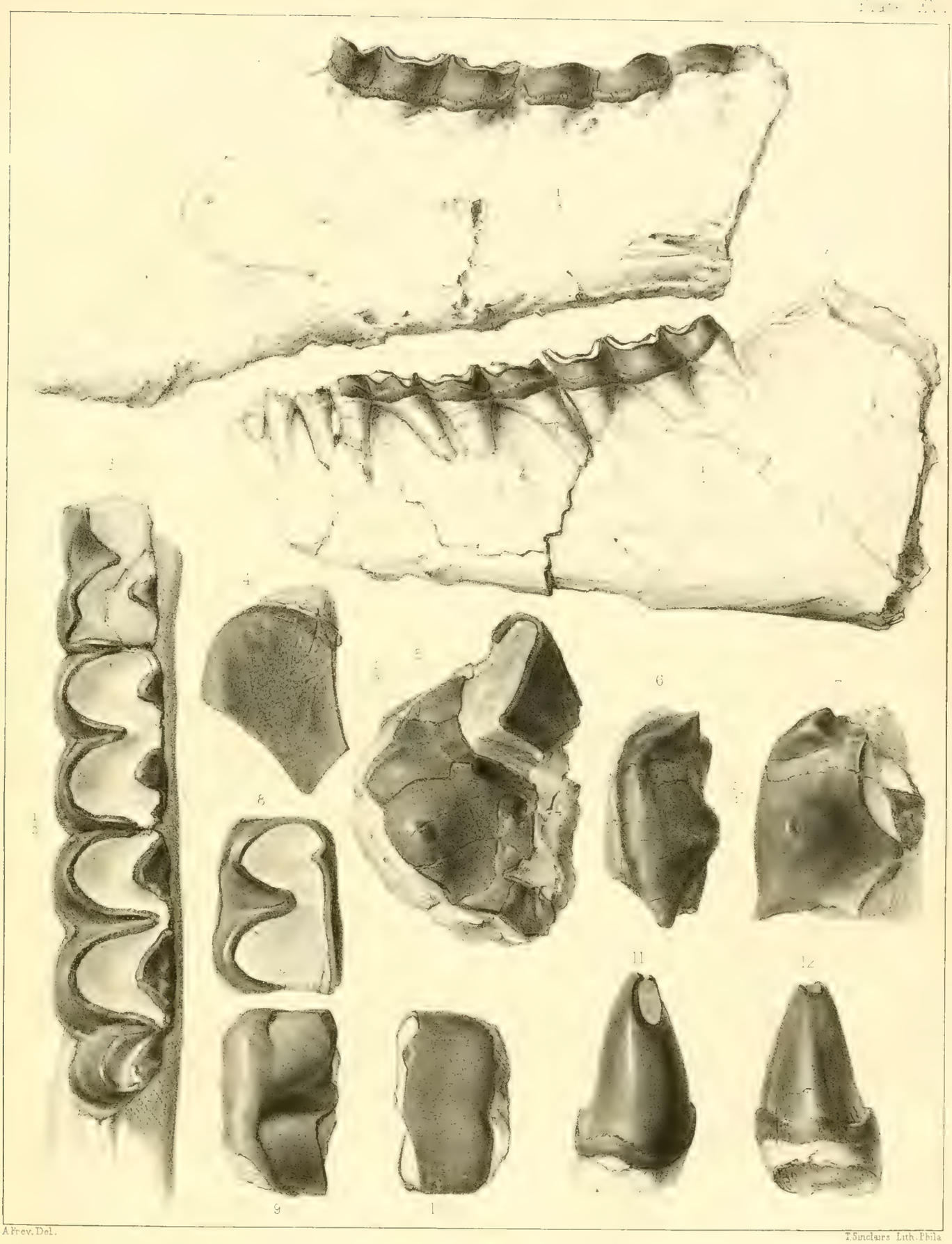


A.Frey Del

PHINOCER. J. HERRAGENSIS Tab. XV



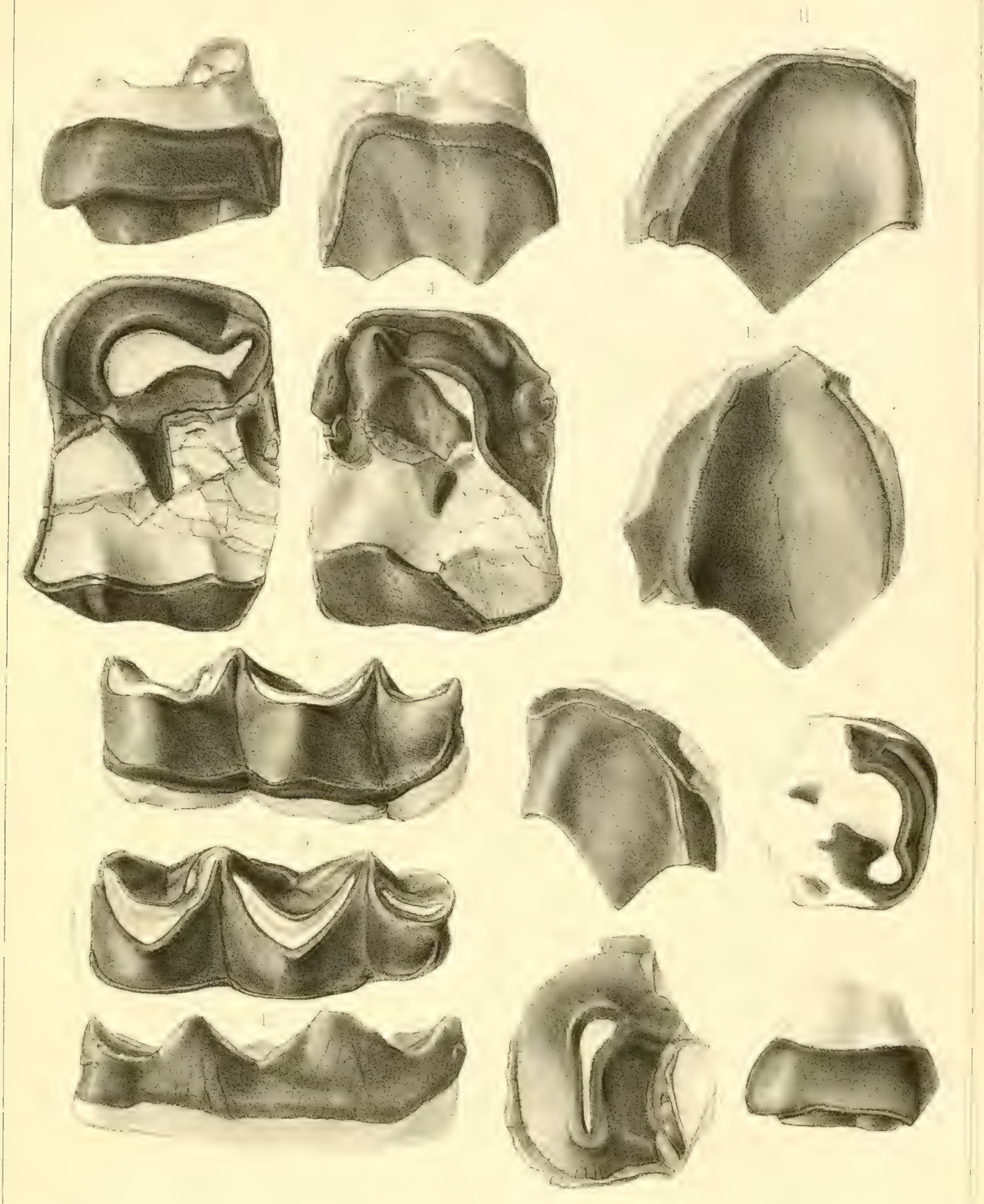
RHINOCEROS NEBRASCENSIS L...

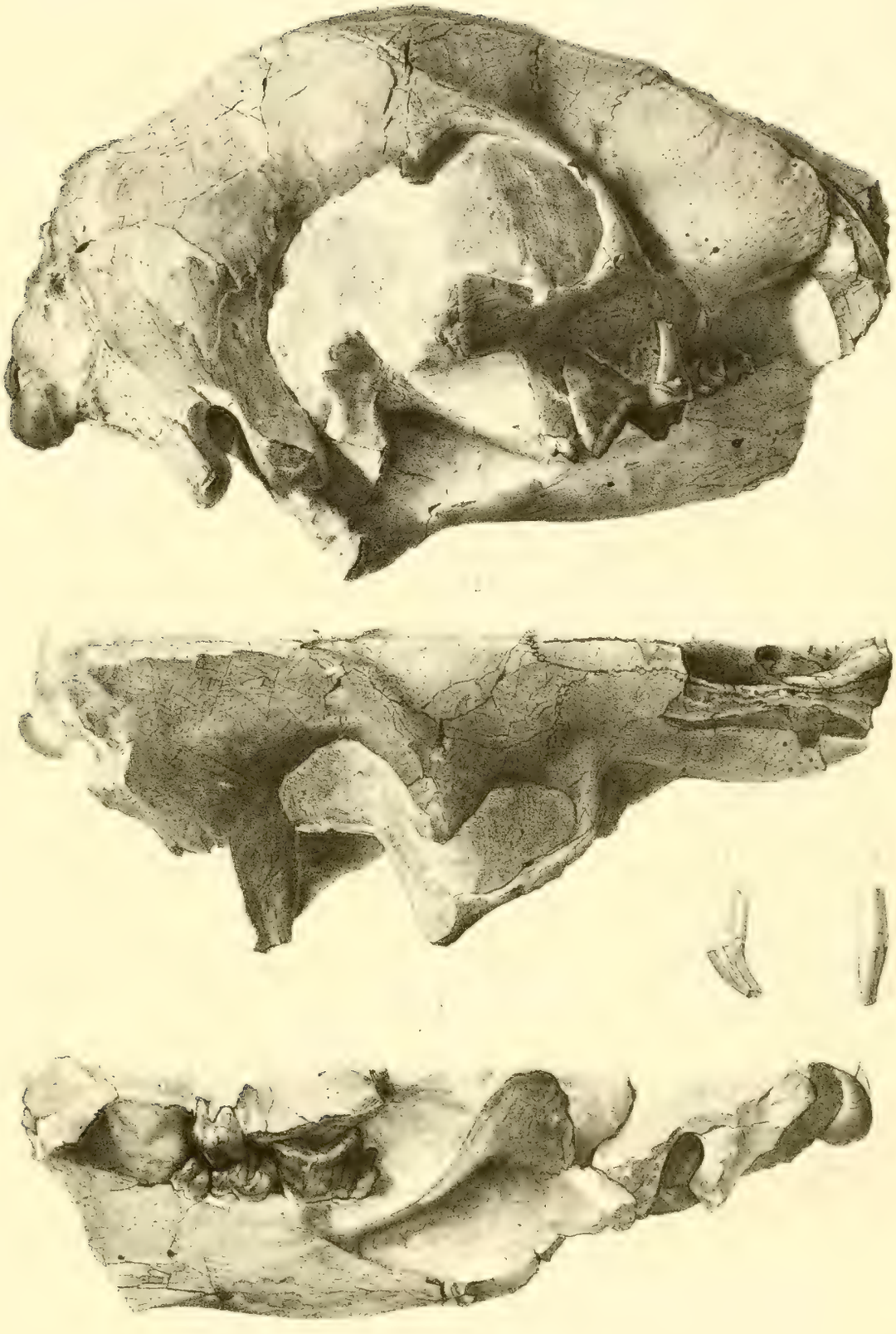


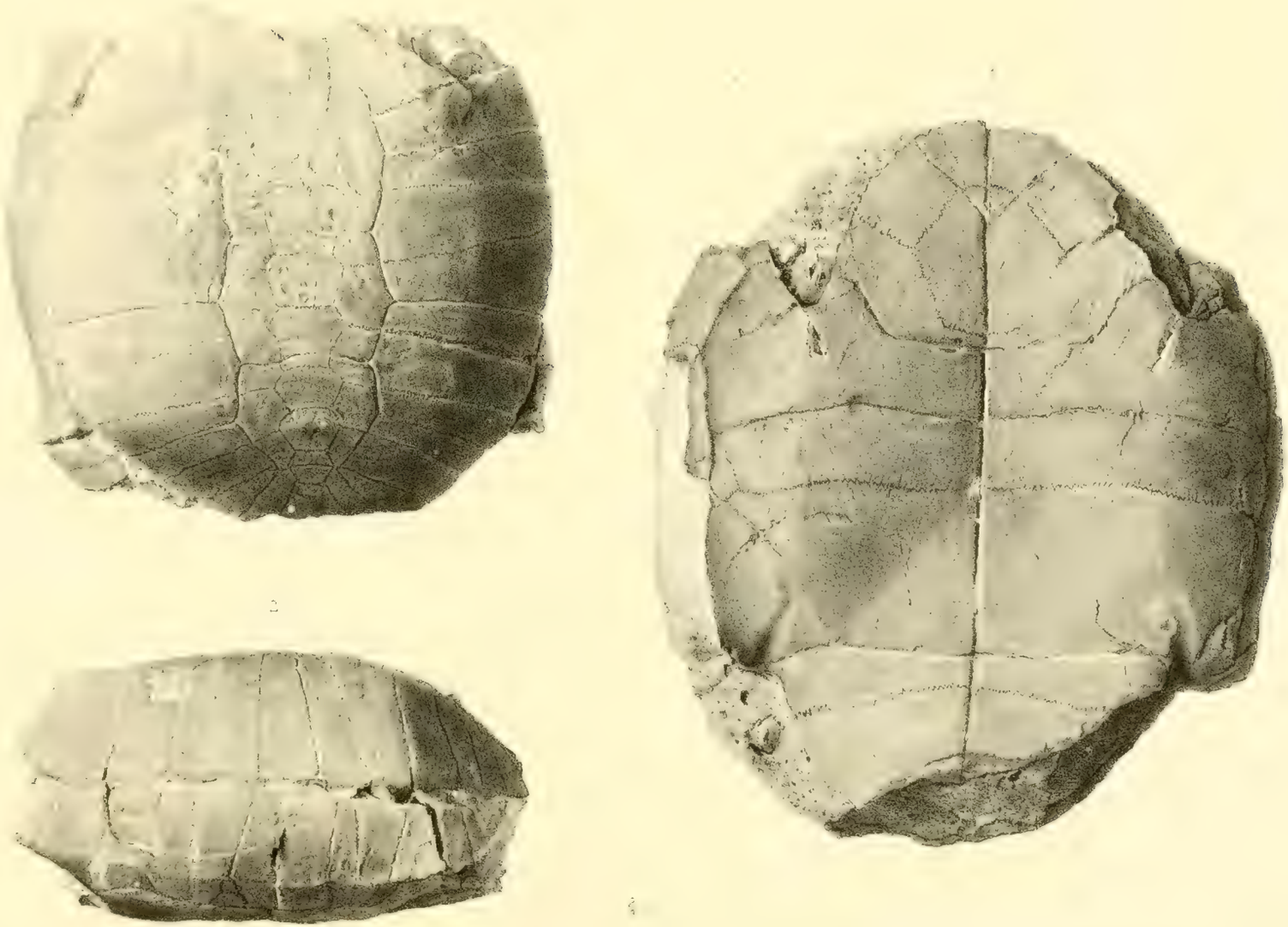
A.Frey, Del.

T.Sinclairs Lith. Phila

TITANOTHERIUM PROUTII, Leidy.

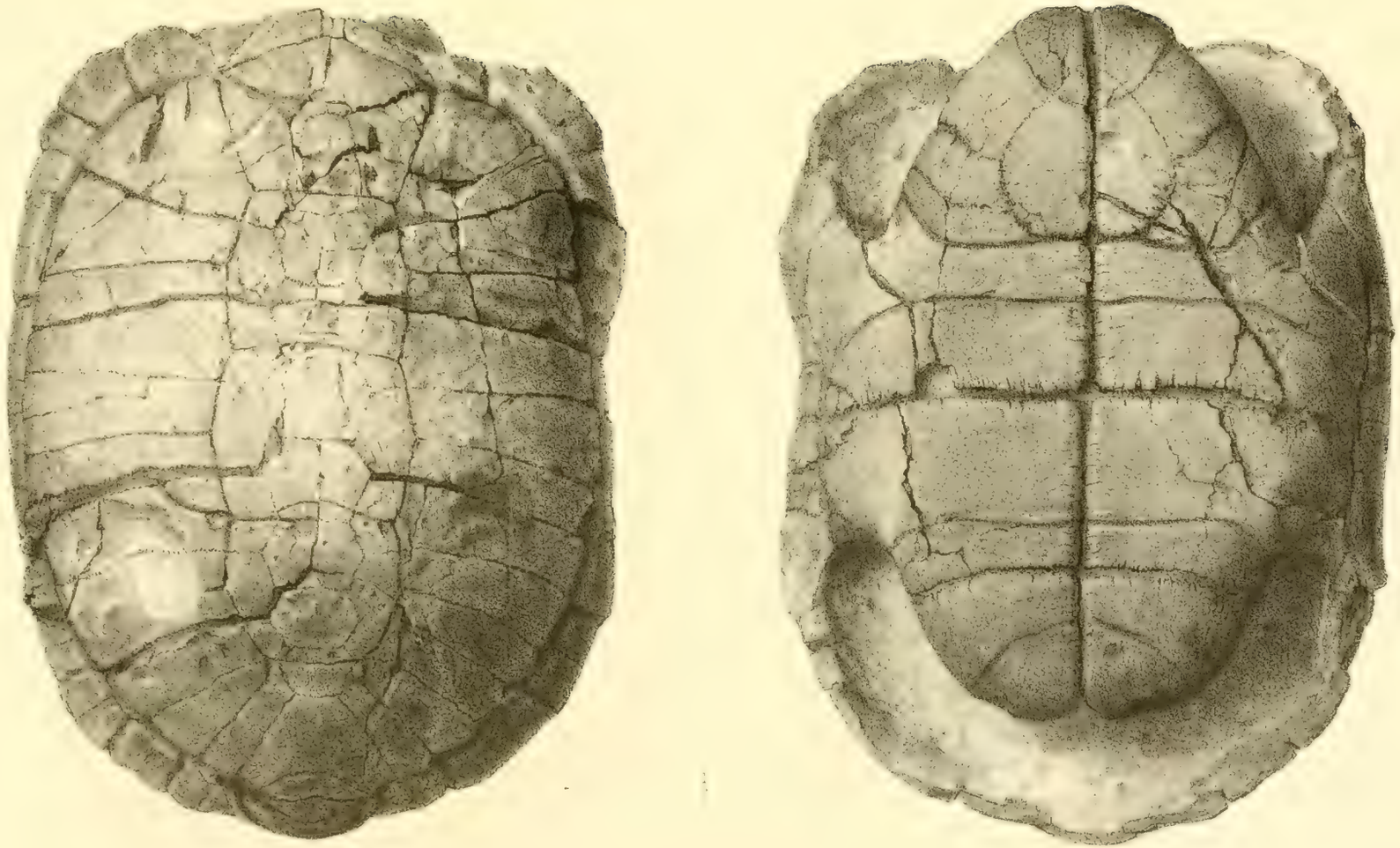






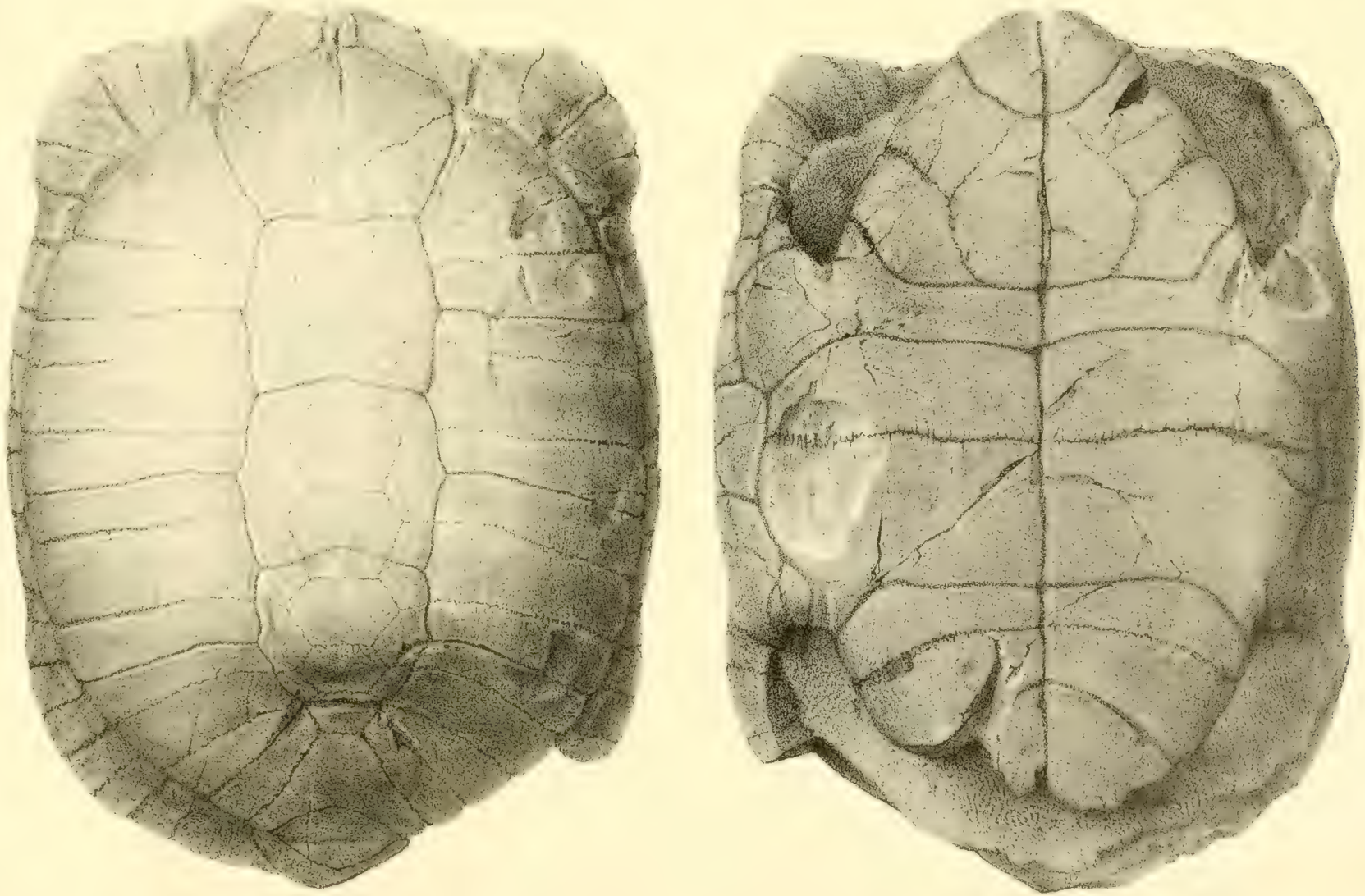
TESTUDO NEBRASCENSIS, Leidy.

T Sinclair's Lith, Phila.



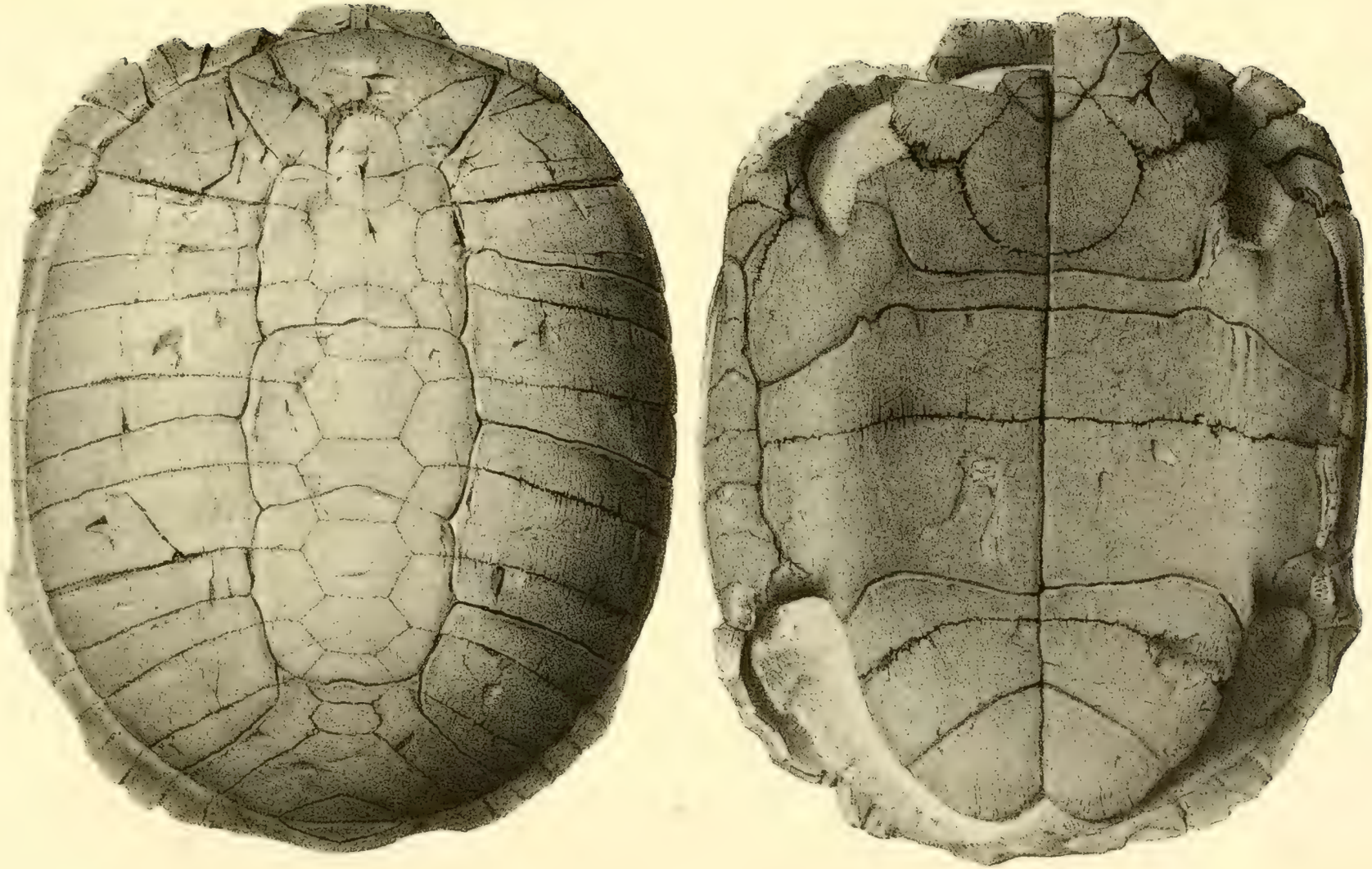
TESTUDO HEMISPHERICA, Leidy.

T. Sinclairs Lith. Phila

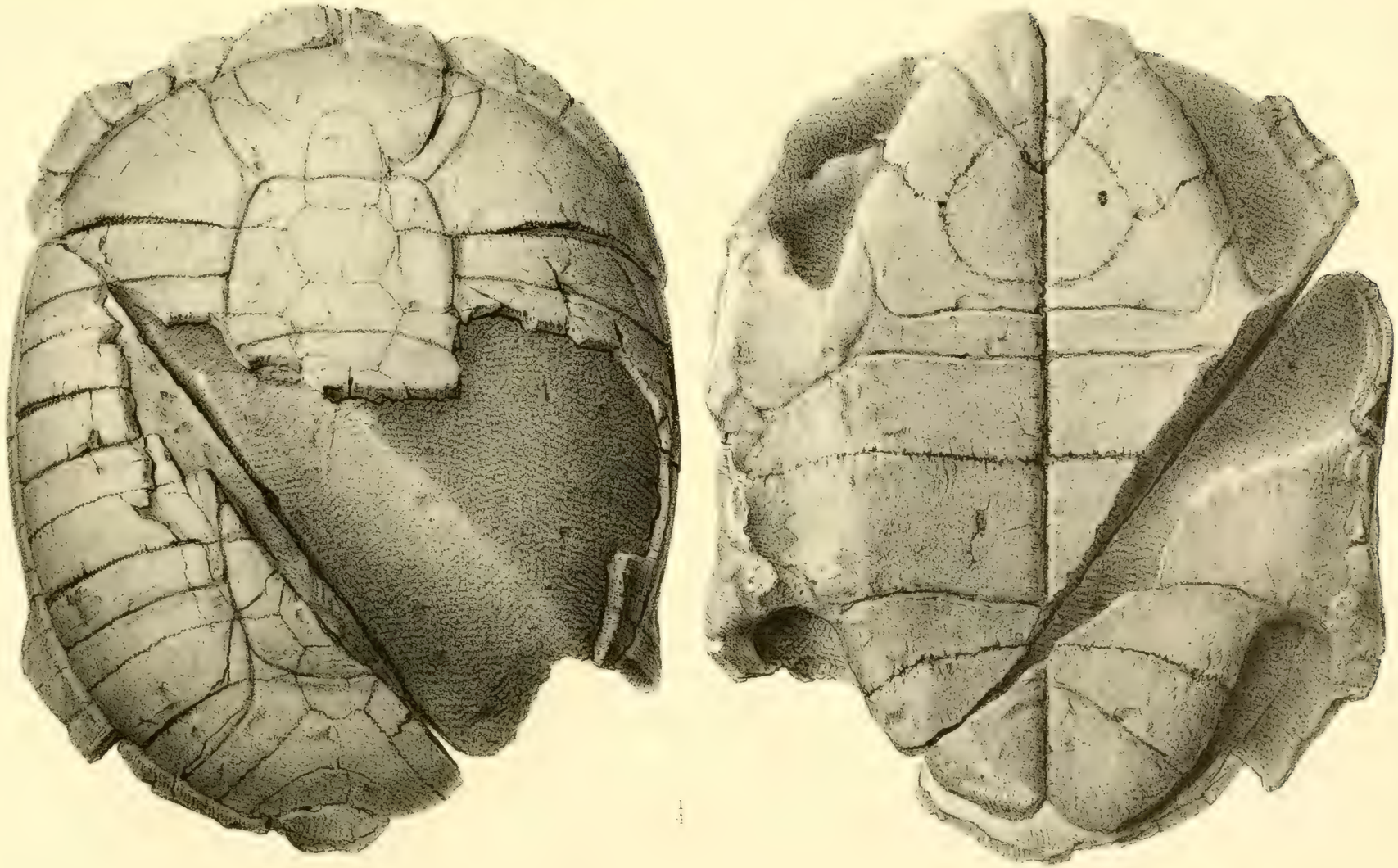


Frey Del.

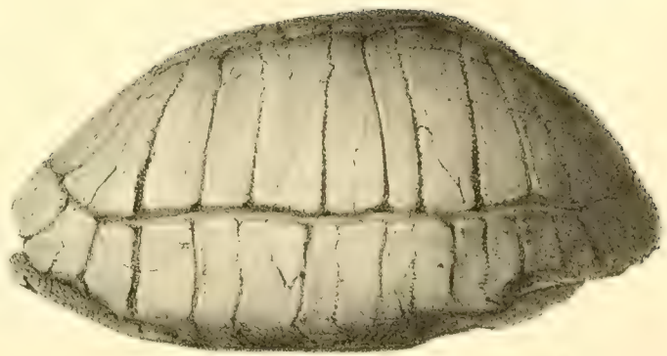
TESTUDO OWENI, Leidy.



ESTUD



A Frey



1. T. LATA. 2. T. CULBERTSONII.
3. T. HEMISPHERICA. 4. T. OWENI.